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Indoor Climate Analyzer
Type 1213

From Serial No.1167965

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Indoor Climate Analyzer

USES

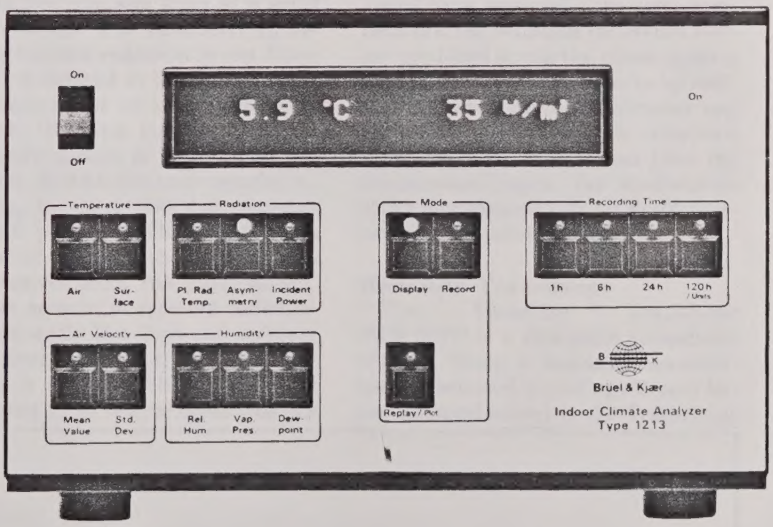
- Measurement of all physical parameters necessary for the evaluation of indoor thermal environments
- Measurement of air temperature and velocity, surface temperature, plane radiant temperature, radiant temperature asymmetry and humidity
- To establish acceptable working environments in offices, light industry, hospitals, etc.
- Evaluation of thermal comfort in aircraft, trains, buses and other transport environments
- Evaluation of complaints concerning indoor thermal environments
- Assessment of the effectiveness of changes to air conditioning and ventilation systems inside buildings and vehicles
- Assessment of the effectiveness of changes to heating and cooling systems inside buildings
- Research into indoor thermal environments

FEATURES

- Easy operation - Type 1213 tells you what to do
- Self-test routines check correct functioning of instrument
- Rapid response time for all measurements
- Five transducer inputs
- One small portable unit enables measurement of all important thermal environmental parameters
- No recalibration when transducers are changed
- Data recording of up to 120 hours in non-volatile memory
- Stores 60 measurements of each parameter throughout pre-selected measurement period
- Large 20 character alphanumeric display
- Linearized analogue outputs
- Several power options available; internal battery, mains or DC supply
- Display and output in either S.I. or Imperial units

The Indoor Climate Analyzer Type 1213 is a unique, compact, direct-reading instrument for measurement of all the essential physical parameters needed to assess indoor thermal environments. It is extremely simple to operate and may be used in buildings and also vehicles which have their own enclosed thermal environments. Results can either be obtained directly from the easy-to-read 20 character alphanumeric display, or stored in the non-volatile memory for subsequent display and/or plotting.

The Type 1213 conforms to the requirements of ISO 7726 "Thermal environments - Instruments and methods for measuring physical quantities."



Introduction

The measurement of several physical parameters is required in order to adequately describe the indoor thermal climate. Amongst the most important of these parameters are air velocity, air temperature, humidity and radiant temperature asymmetry. The Indoor Climate Analyzer Type 1213 and its Transducers measures these and other parameters.

The Type 1213 Analyzer consists of a portable, battery or mains powered instrument which simultaneously senses environmental conditions via five separate Transducers. The Transducers are connected by cables to the Type 1213 and four of the Transducers can be mounted on a light-weight, photographic-type tripod. The fifth Transducer is for measurement of surface temperature and is hand-held in contact with the surface(s) under investigation.

A Delta Arm and 4 Tripod Mounting Adaptors are included with the Type 1213 and five Transducers when the Indoor Climate Analyzer Measuring Set Type 3532 is ordered (Fig. 1). A Tripod can also be supplied as an optional accessory.

Measurements obtained using the Indoor Climate Analyzer can be read directly from the Display, or stored in the non-volatile memory and subsequently plotted on an X - Y Recorder such as B & K Type 2308. A Level Recorder, such as B & K Types 2309 and 2317 may also be used.

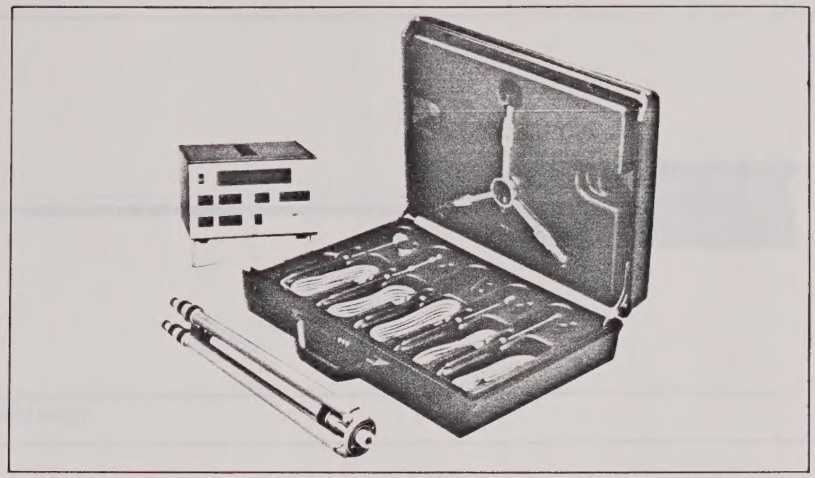


Fig. 1 The Indoor Climate Measuring Set Type 3532 and optional Tripod

Description

Air Temperature Transducer

The Air Temperature Transducer (MM 0034) shown in Fig. 2 is based on an extremely accurate, platinum (Pt100) resistance temperature sensing element. This resistor is surrounded by an open-ended radiation shield, which reduces the thermal radiation effects of the environment. Since platinum has a well defined temperature coefficient, air temperature can be accurately measured by a change in resistance.

Surface Temperature Transducer

The Surface Temperature Transducer (MM 0035) shown in Fig. 3 is also based on a Pt100 resistor attached to a thin diaphragm. The diaphragm is simply placed in contact with the surface whose temperature is to be measured. The diaphragm is attached to a conical housing which protects the temperature sensing element. Additional protection is also provided by a spring loaded attachment between the sensor and the transducer handle. This spring system also enables surface temperature measurements to be obtained from surfaces which are not perpendicular to the transducer handle.

Radiant Temperature Asymmetry Transducer

The Radiant Temperature Asymmetry Transducer (MM 0036) consists of two identical faces (A and B) which independently measure incident radiation on each plane surface (Fig. 4).

Radiant temperature asymmetry (Δt_{pr}) is defined as the difference between the plane radiant temperature (t_{pr}) on two opposite sides of a small black element. The parameter t_{pr} describes the heat radiation in one direction. It is defined as the uniform surface temperature of a half room that produces the same incident radiation on a black surface as the actual environment. In addition to measuring t_{pr} and Δt_{pr}, the MM 0036 also measures incident power which is the gross amount of radiation that a black surface receives from the environment. The net amount of received radiation is significantly less than the incident power because the surface itself radiates as it is above 0 K (-273°C). By measuring t_{pr} in several directions the mean radiant temperature can also be calculated.

Each face of the Transducer consists of a reflective gold-plated element and a black painted element of the same size. Both elements are connected to a centreblock via thermopiles. When either heated or cooled by the environment, the gold-plated element gains or looses heat entirely by convection whereas the black element looses or gains heat both by convection and radiation. Thus, as both elements have essentially the same temperature, the resultant difference voltage produced across the thermopiles is a function of the heat transfer by radiation between the black element and the environment. The t_{pr} is calculated from this measurement and from the temperature inside the centreblock which is measured using a Pt100 temperature sensitive resistor.

Humidity Transducer

The Humidity Transducer (MM 0037) is a dew-point transducer (Fig. 5). When a humidity measurement is selected, a cooling element below a conical mirror in the Transducer

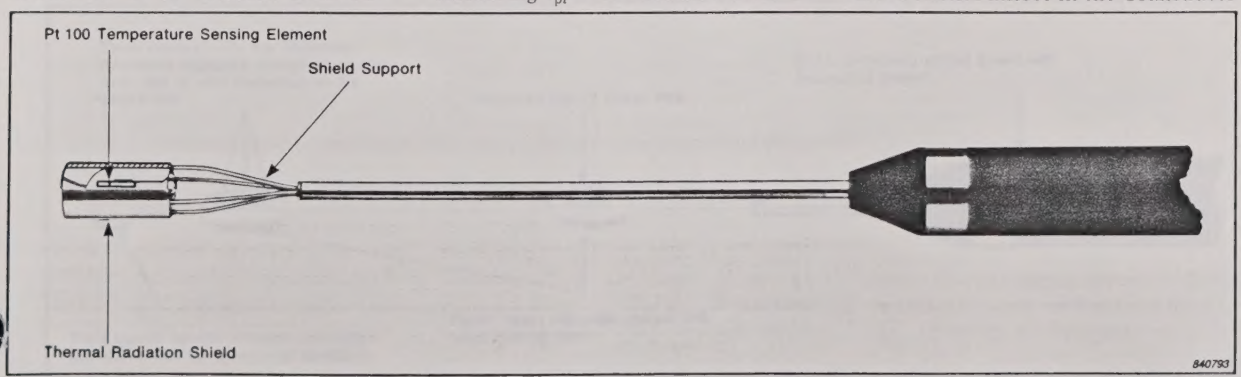


Fig. 2 Air Temperature Transducer (MM 0034)

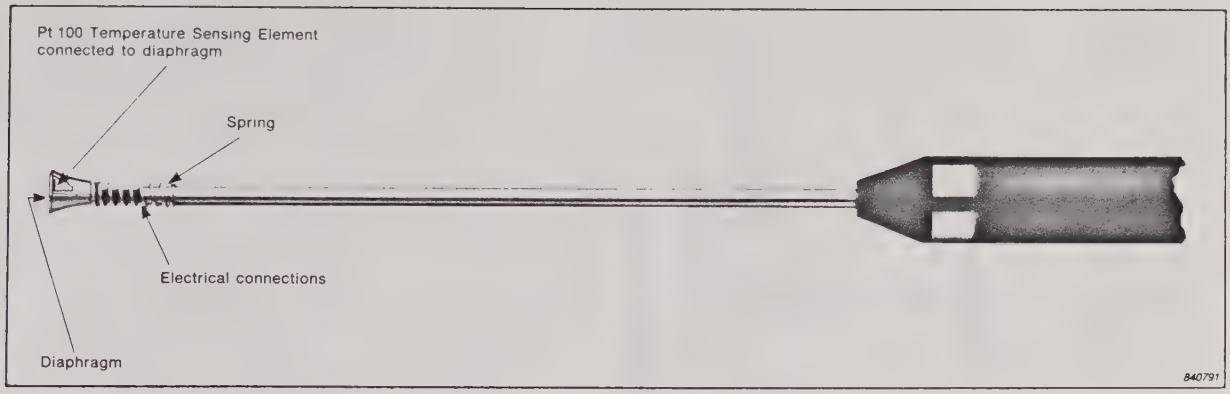


Fig. 3 Surface Temperature Transducer (MM 0035)

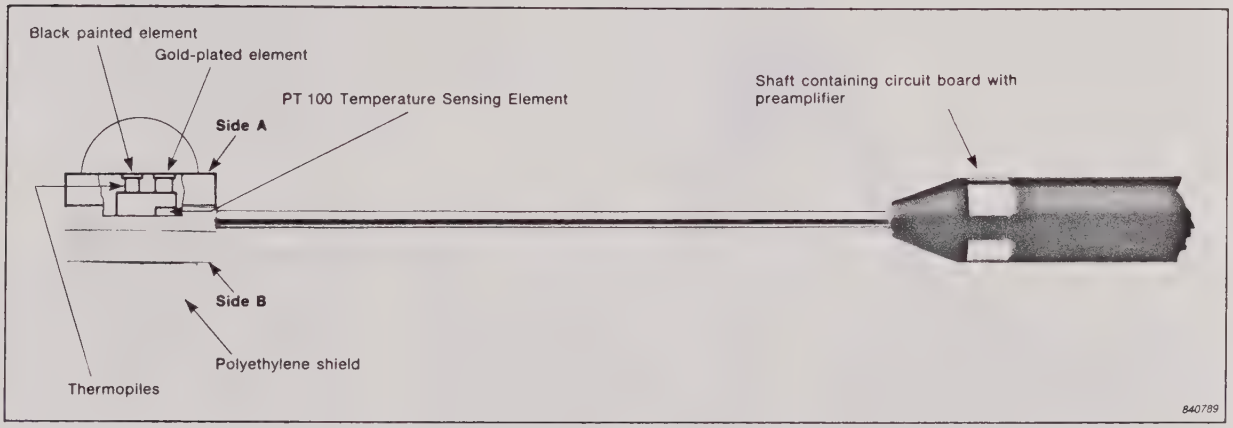


Fig. 4 Radiant Temperature Asymmetry Transducer (MM 0036)

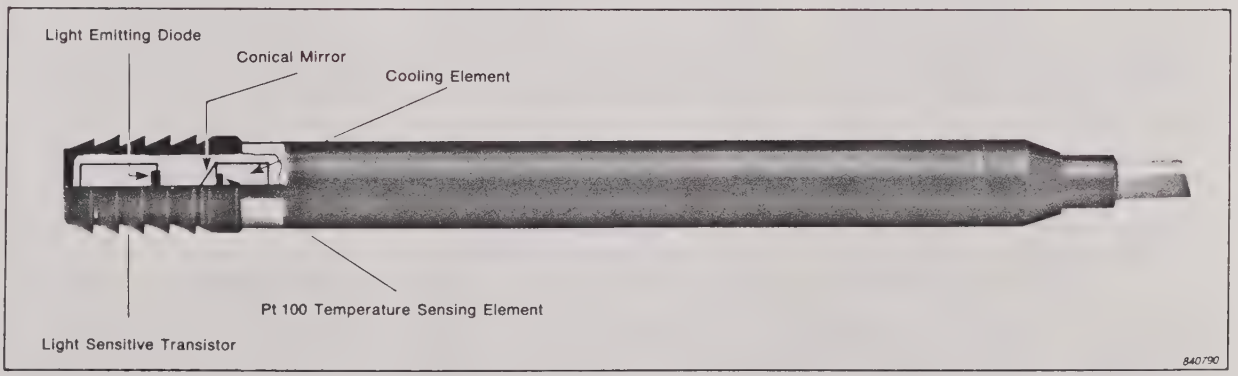


Fig. 5 Humidity Transducer (MM 0037)

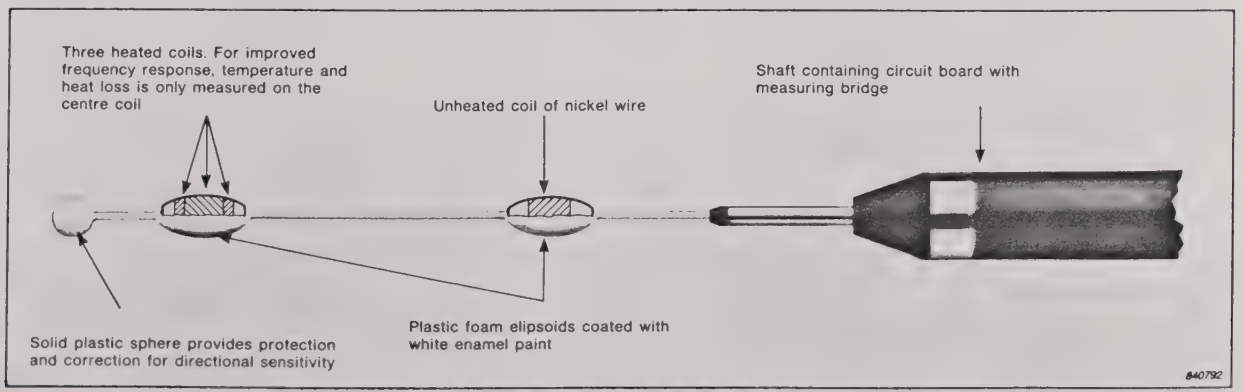

Three heated coils. For improved
frequency response, temperature and
heat loss is only measured on the
centre coil
Unheated coil of nickel wire
Shaft containing circuit board with
measuring bridge
Solid plastic sphere provides protection
and correction for directional sensitivity
Plastic foam elipsoids coated with
white enamel paint
840792

Fig. 6 Air Velocity Transducer (MM 0038)

is activated, reducing the mirror temperature until condensation of atmospheric water vapour occurs. The temperature at which this water vapour condenses on the mirror surface is known as the dew-point.

Above the mirror there is a Light Emitting Diode (LED) and a light sensitive transistor (receiver). These are arranged so that light from the LED is not normally detected by the receiver. However, when condensation occurs, a film of dew coats the mirror. Light from the LED is then scattered by the dew, some of it being detected by the receiver. An electronic circuit regulates the cooling of the mirror so as to maintain a stable film of dew. When the temperature has stabilized the dew is assumed to be stable and the mirror temperature is measured by a Pt100 temperature sensing element below the mirror.

To conserve power, a dew-point measurement is taken only every third minute. The presence of bodies capable of emitting water vapour may cause the dew-point to vary slightly. When the measured dew-point is unstable, a message to that effect is displayed.

Air Velocity Transducer

The Air Velocity Transducer (MM 0038) is based on the constant temperature anemometer principle. Air velocity is measured as a function of the heat loss from a heated body, by measuring the power input required to maintain a constant temperature difference between the two sensor elements (Fig. 6).

The heat loss is, however, also a function of the temperature and direction of the airflow, and the radiative exchange with the surroundings. The errors associated with these effects are eliminated through the design and construction of the MM 0038 which uses two identical temperature sensitive ellipsoidally shaped bodies, one of which is heated and the other unheated. The eccentricity of the ellipsoids and the length of the heating coils are optimised to give the smallest possible variation in directional sensitivity. The controlled electrical heating maintains a constant temperature difference of 15°C (27°F), independent of the ambient temperature, between the two bodies.

Inputs

The five different types of Transducer can be simultaneously connected to the Analyzer. (Tripod mounting of four of the Transducers is shown in Fig. 7). With the exception of the Air and Surface Temperature Transducers, the Transducers have different input plugs, which eliminates the possibility of incorrect connections. The Air and Surface Temperature Transducers have identical inputs enabling either two Air or two Surface Temperature Transducers to be used at the same time.

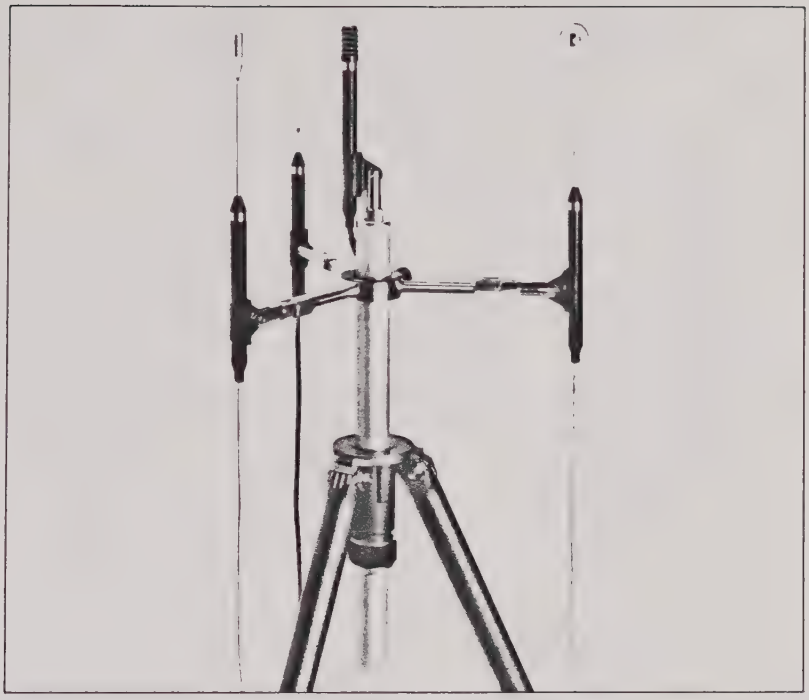


Fig. 7 Four Transducers mounted on the Delta Arm and Tripod

A system configuration of the Indoor Climate Analyzer Type 1213 is shown in Fig. 9. Signals from the Transducers are fed into analogue circuits which provide signal conditioning. The analogue signals are then converted to digital data via a twelve bit A/D Converter.

Microcomputer

Contained within the Microcomputer are a real time digital clock, a ROM (Read Only Memory) for program and algorithm storage and a RAM (Random Access Memory) for storage of the measured data. The Type 1213 also incorporates a D/A Converter which provides linearized analogue signals to the analogue outputs on the rear panel of the Type 1213.

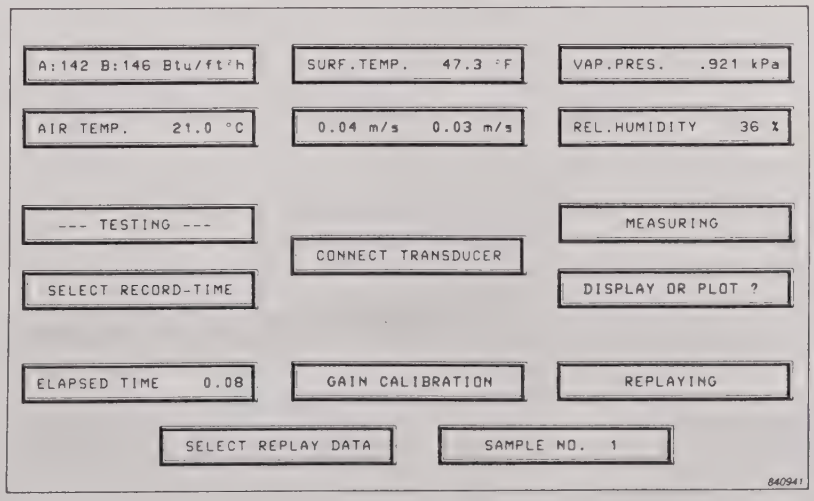


Fig. 8 Examples of some of the Indoor Climate Analyzer Type 1213 Displays

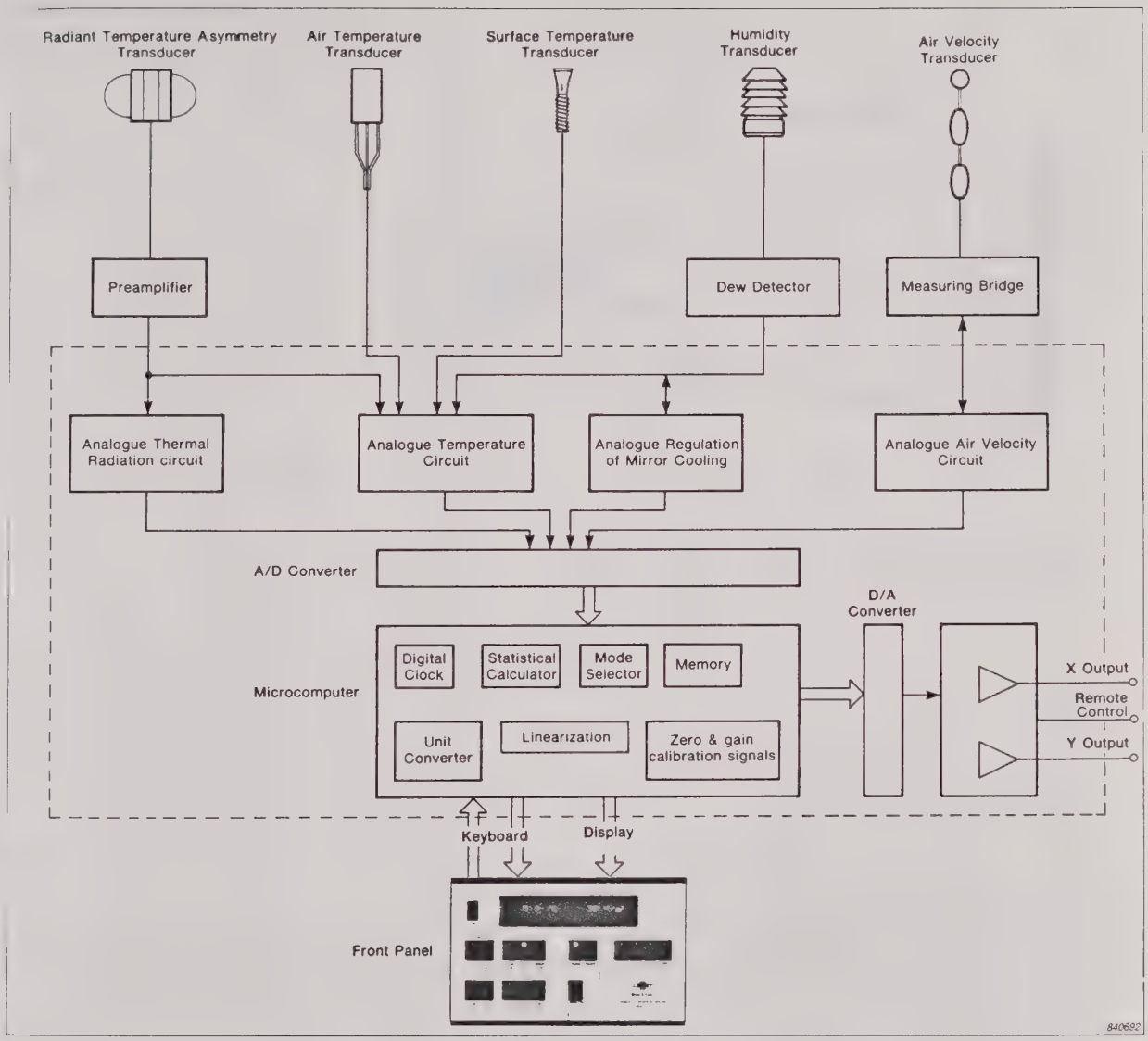


Fig. 9 System configuration for the Indoor Climate Analyzer Type 1213

Memory

The RAM is powered by a small built-in lithium battery. This internal battery ensures that the data are retained (for more than 5 years) even when the Analyzer is switched off or the main power supply is disconnected. A series of up to sixty measurements of each parameter can be retained in the Memory. The selected measurement duration over which the recording was obtained is also stored.

Display

The Type 1213 has a bright 20 character alphanumeric Display. As well as providing numerical data, this Display provides easy-to-understand guidance on the Analyzer's use. Some information and data that can be obtained on the Display is shown in Fig. 8.

The Indoor Climate Analyzer incorporates a number of self-test functions. When these tests find a fault an appropriate error message appears on the Display.

Controls

All pushkeys are situated on the front panel of the instrument and are grouped into three sections: transducer controls, operating mode selection and recording time selection (see Figure on front page).

The transducer selection controls on the left hand side of the Analyzer are in turn divided into four groups; "Temperature", "Radiation", "Air Velocity" and "Humidity".

Temperature

The "Temperature" section consists of two pushkeys which are used to select either the "Air" or the "Surface" Temperature Transducer.

Radiation

The "Radiation" section has three pushkeys which select the way in which the signal from the Radiant Temperature Asymmetry Transducer is presented. Incident thermal radiation on the two opposing faces of the Transducer can be displayed either in temperature units or in terms of the incident power. Alternatively, the difference in incident thermal radiation, known as the radiant temperature asymmetry (Δt_{pr}), between the two faces of the Transducer can be displayed using the "Asymmetry" push-

key. The asymmetry data can be displayed either in numerical form, or as a bargraph (by pressing "Asymmetry" twice). This latter display is particularly useful when finding the direction of maximum temperature asymmetry.

Air Velocity

The "Air Velocity" section has two pushkeys; "Mean Value" and "Std. Dev". When "Mean Value" is selected two values are obtained on the Display. The left-hand value is the air velocity measured with a 5 second time constant, while the right-hand value is a linear three-minute-mean air velocity. The displayed three-minute value is updated every 10 seconds. The "Std. Dev." pushkey also provides two values on the Display. These are the standard deviations for the 5 second and three minute measurements.

Humidity

The "Humidity" section consists of three pushkeys; "Rel. Hum.", "Vap. Pres." and "Dewpoint". Measurements of relative humidity can only be obtained if both the Air Temperature and Humidity Transducers are connected to the Analyzer. The atmospheric partial water vapour pressure (measured in kPa.) can be displayed using the "Vap. Pres." pushkey, while the dew-point temperature is obtained using the "Dew-point" pushkey.

Mode

Three pushkeys ("Display", "Record" and "Replay/Plot") determine the operating mode of the Indoor Climate Analyzer. These pushkeys are grouped in the centre of the front panel and their operation is described in the "Operation" section below.

Recording Time

The "Recording Time" pushkeys on the right-hand side of the front panel are normally only activated in the "Record" mode, when they are used to select the measurement period over which the data are to be recorded. A choice of four periods (1, 6, 24 and 120 hours) is available. However, in either "Display" or "Replay/Plot" mode, the "120 h/Units" pushkey converts the displayed data from S.I. to Imperial units or vice versa.

Outputs

The Indoor Climate Analyzer has three output sockets on the rear panel (2 BNC and one 8-pin "Recorder"). The output obtained is dependent upon the operating mode of the Type 1213 (see "Operation" section).

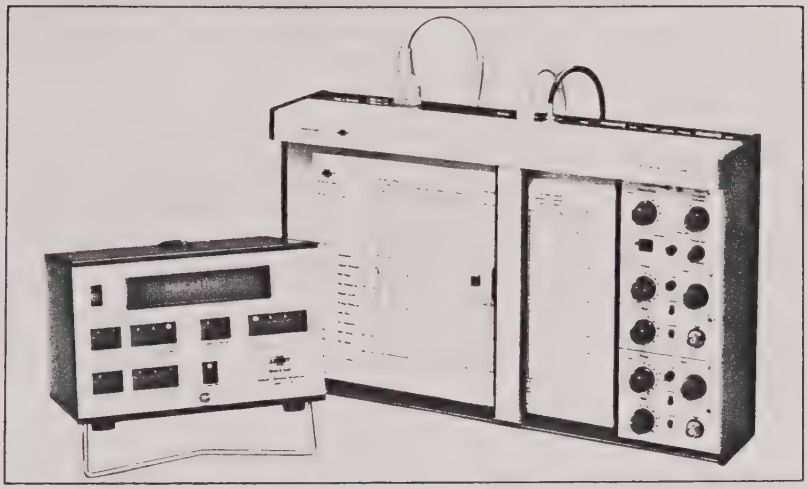


Fig. 10 Output of recorded data from Type 1213 to Type 2308 X–Y Recorder

In "Replay" mode, data stored in the Memory can be obtained via the outputs. In "Display" and "Record" modes, the current data which is on the Display is available. The output can thus be determined by the parameter pushkey selected. When air velocity measurements are selected, a linearized voltage proportional to the instantaneous air velocity is obtained on the X–output and one proportional to the 5 second measurement on the Y–output.

The outputs can be connected to an X–Y Recorder such as B & K Type 2308 as shown in Fig. 10, or one of the B & K range of Level Recorders may be used. Special recording paper (in either S.I. or Imperial units) is available for use with the B & K Chart Recorder Type 2308. An example of a recording is shown in Fig. 11.

Power Supply

The Analyzer is supplied with 6 alkaline batteries (QB 0004), contained in a detachable Battery Box. Alternatively, rechargeable NiCd cells (available as optional accessories) may be used. If the battery supply should run down, the warning "BATTERY LOW" appears on the Display.

Rechargeable cells can be charged in-situ using Battery Charger ZG 0113 (also available to order) or any other suitable DC power supply. An option-

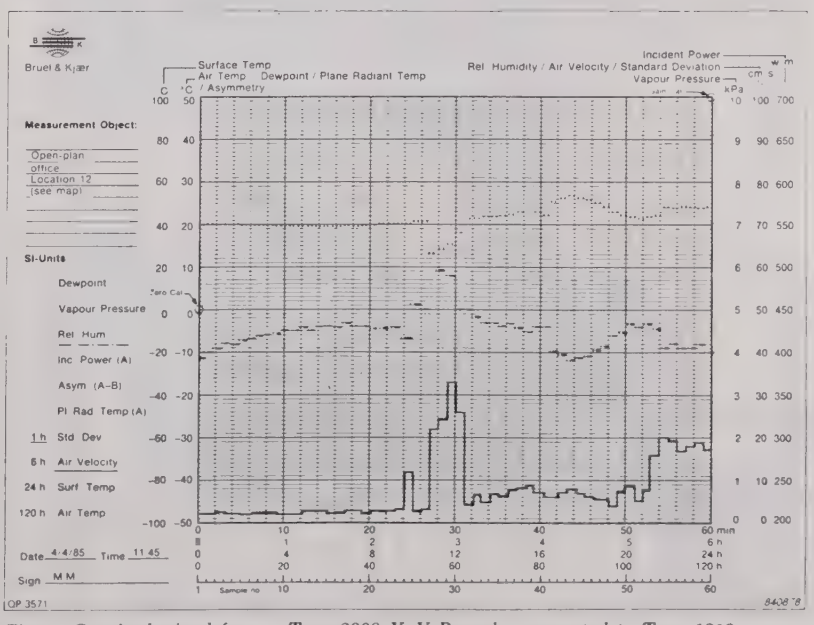


Fig. 11 Graph obtained from a Type 2308 X–Y Recorder connected to Type 1213

al Mains Power Supply (ZG 0199) enables the Type 1213 to be powered continuously from the mains and can also be used as a battery charger.

Operation

The Indoor Climate Analyzer has three operating modes: "Display", "Record" and "Replay/Plot".

Display Mode

Each time the instrument is switched on, it automatically enters the "Display" mode. Immediately after switching on, the Type 1213 undergoes a short internal self-testing routine in which the basic functions such as the A/D conversion, validity of the program in the ROM and the functioning of the RAM are checked. Thereafter, data can be read directly from the Display by selecting the desired pushkey.

The selection of measurement data for display depends upon the pushkey selected. In most cases the measurements are displayed instantly. However, if either "Air Velocity" or "Humidity" parameters are selected as soon as the instrument is switched on, a delay occurs during which the first measurement takes place. During this initial delay period the Display indicates that the instrument is "MEASURING". Subsequent selections of either "Air Velocity" or "Humidity" measurements provide instantaneous displays of the last measured value.

In the "Display" mode it is also possible to obtain instantaneous air velocity measurements via the X–output on the rear panel of the Type 1213.

Record Mode

The "Record" mode of the Type 1213 is used to select, automatically measure and record data. The user can choose between the four different measurement periods by using the "Recording Time" pushkeys. The Type 1213 automatically spaces the measurements equally throughout the pre-selected measurement period.

Provided that all five different transducers are connected to the Indoor Climate Analyzer, simultaneous recording of all measurement data is possible. If a measurement is selected for recording when the relevant transducer(s) are not connected, "CONNECT TRANSDUCER" appears on the Display. Thus, the operator can ensure that the required transducers are connected, before the recording takes place.

Once the recording period has commenced the Indoor Climate Analyzer automatically switches to a low power mode extending battery life. In this low power mode the Display remains blank and all LEDs with the exception of the "Record" pushkey LED are extinguished.

It is possible to obtain data on the Display whilst still recording, by pressing the "Display" pushkey. The requisite measurement can then be obtained on the Display by selecting the appropriate pushkey. In addition to the data being measured, it is also possible to obtain a read-out of the elapsed measurement period.

If left in the activated state for of four minutes without any pushkeys being operated, the Analyzer automatically reverts to the low power mode.

When the full recording period has been completed the Indoor Climate Analyzer remains in the low power mode. However, the LED on the "Record" pushkey flashes to indicate that recording and storage of data have been completed.

Replay/Plot Mode

The third operating mode of the Type 1213 is "Replay/Plot", which is used to recall data stored in the Analyzer Memory. Stored data can either be replayed on the Display, or output to a graphic recorder via the rear panel sockets on the Analyzer.

When replaying data on the Display, the user can either step through all recorded data for a single parameter, or alternatively, look at all data recorded at one measurement interval. Stored data are labelled with a "SAMPLE NO." and the Display automatically alternates between sample number and recorded data.

When plotting data, the Type 1213 provides both zero and gain calibration signals. Plotting data from the Type 1213 is particularly easy with the B & K X–Y Chart Recorder, for which special graph papers (QP 3571 and QP 3572) are available. However, other X – Y Recorders and Level Recorders may also be used.

Applications

In workplaces, such as offices or electronic assembly halls, where activity is predominantly sedentary, the thermal environment often plays a

Fig. 12 Application of the Indoor Climate Analyzer Type 1213 in a museum

major role in creating satisfactory conditions. Thus, the Indoor Climate Analyzer has widespread applications in the heating and air-conditioning fields, both in buildings and vehicles.

The Analyzer can be used in conjunction with the Thermal Comfort Meter Type 1212 to help in the provision of more acceptable working, travelling or leisure conditions. Using the Type 1213, measurements can be conducted to see if an existing environment is satisfactory, or to determine the type and size of any improvements to heating and air conditioning plant that are required. Once changes have been made, the Analyzer can be used to assess whether the improvements are effective. It can also be used to investigate complaints from staff and provide quantitive data to help overcome the problems encountered.

Fig. 13 Application of the Indoor Climate Analyzer Type 1213 in a production hall

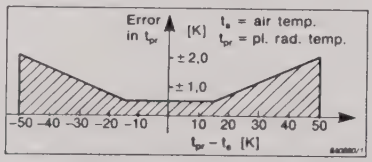
Specifications Type 1213 and Transducers

Stated measurement ranges and accuracies are for the combination of Type 1213 and transducer

AIR TEMP. TRANSDUCER (MM 0034):
Measurement Range: – 20 to 50°C (– 4 to122°F)
Response Time: 20 s to 50% of step change, 50 s to 90% in still air
Accuracy: 5 to 40°C range: ± 0,2°C
(41 to 104°F range: ± 0,4°F)
– 20 to 50°C range: ± 0,5°C
(– 4 to 122°F range: ± 0,9°F)

SURFACE TEMPERATURE TRANSDUCER (MM 0035):
Measurement Range: – 20 to 100°C (– 4 to 212°F)
Response Time: 2 s to 50%, 7 s to 90%
Accuracy: 5 to 40°C range: ± 0,5°C
(41 to 104°F range: ± 0,9°F)
– 20 to 100°C range: ± 1,0°C
(– 4 to 212°F range: ± 1,8°F)

RADIANT TEMPERATURE ASYMMETRY TRANSDUCER (MM 0036):
Measurement Range: t_a ± 50°C (± 90°F)
Response Time: 15 s (50%), 60 s (90%)
Accuracy:



HUMIDITY TRANSDUCER (MM 0037):
Dew Point Range: $t_a - t_d < 25°C$ (45°F)
Accuracy: $t_a - t_d < 10K$: ± 0,5K
$10K < t_a - t_d < 25K$: ± 1,0K
Measuring Time: Typically 1 minute
Measuring Interval: 2 minutes

AIR VELOCITY TRANSDUCER (MM 0038):
Measurement Range: 0,05 to 1 m/s (10 to 200 ft/minute)
Response Time: 0,2 s to 90% of step change
Accuracy: Laminar and turbulent air flows, ± 5% ± 0,05 m/s (10 ft/min) for any flow direction greater than 15° from rear of transducer axis

DATA RECORDING:
Recording Periods: 1, 6, 24 and 120 hours
Storage: 60 values of each pre-selected parameter evenly spaced over selected measurement period

DISPLAY:
20 character alphanumeric Display for push-key selectable data read-out. User guidance is also provided on Display

RECORDER OUTPUTS:
2 BNC sockets accept JP 0035 plugs. Provide X & Y analogue outputs for X–Y Recorder
Voltage Range: – 5 V to + 5 V
Output Impedance: < 50 Ω
Minimum Load Impedance: 10 kΩ

POWER SUPPLY:
Internal Power Suppy: Plug-in battery pack with 6 IEC R20 alkaline batteries (supplied) **or** 6 NiCd rechargeable cells.
External Power Supply: Standard DIN connector for external 6 to 15 V DC supply according to safety class 3 measure **or** Battery/mains Power Supply according to safety class 2 measures

ENVIRONMENT:
Operating Temp: 5 to 40°C (41 to 104°F)
Storage Temp: (1213 and Transducers) -25 to 70°C (-13 to 158°F).
Humidity: 90% non-condensing
Electromagnetic: Complies with U.S. FCC requirements, Class B

WEIGHT:
3,1 kg inc. batteries (6,8 lbs)

DIMENSIONS:
Height: 133 mm (5,2 in)
Width: 210 mm (8,3 in)
Depth: 200 mm (7,9 in)

ACCESSORIES INCLUDED WITH 1213:

Battery Box	ZG 0146
6 Alkaline Batteries (IEC LR20)	QB 0004
7-pin DIN plug for ext. power supply	JP 0703
4-pin DIN plug for Pt–100 temperature measurements	JP 0402
2 BNC Coaxial Plugs	JP 0035
2 T2A fuses	VF 0010
Recording Paper for 2308 (metric)	QP 3571
Recording Paper for 2308 (imp.)	QP 3572

ACCESSORIES INCLUDED WITH INDOOR CLIMATE ANALYZER MEASURING SET TYPE 3532:

Indoor Climate Analyzer	Type 1213
Air Temperature Transducer	MM 0034
Surface Temperature Transducer	MM 0035
Rad. Temp. Asymmetry Transducer*	MM 0036
Humidity Transducer	MM 0037
Air Velocity Transducer	MM 0038
Transducer Carrying Case	KE 0234
Tripod Mounting Adaptor (4 supplied)	UA 0588
Delta Arm	DH 0492

ACCESSORIES AVAILABLE:

Air Temperature Transducer	MM 0034
Surface Temperature Transducer	MM 0035
Rad. Temp. Asymmetry Transducer*	MM 0036
Humidity Transducer	MM 0037
Air Velocity Transducer	MM 0038
Portable Tripod	UA 0587
Rechargeable NiCd Cell (6 required)	QB 0008
Battery Charger	ZG 0113
Mains Power Supply	ZG 0199
Control Cable for X–Y Rec. Type 2308	AQ 0034
Signal Cable for recorders	AO 0087
Recording Paper for 2308 (metric)	QP 3571
Recording Paper for 2308 (imp.)	QP 3572
Recording Paper for 2317	QP 0102

*Includes 16 Radiation Transparent Windshields ..... UA 0851

2. CONTROLS

2.1. FRONT PANEL

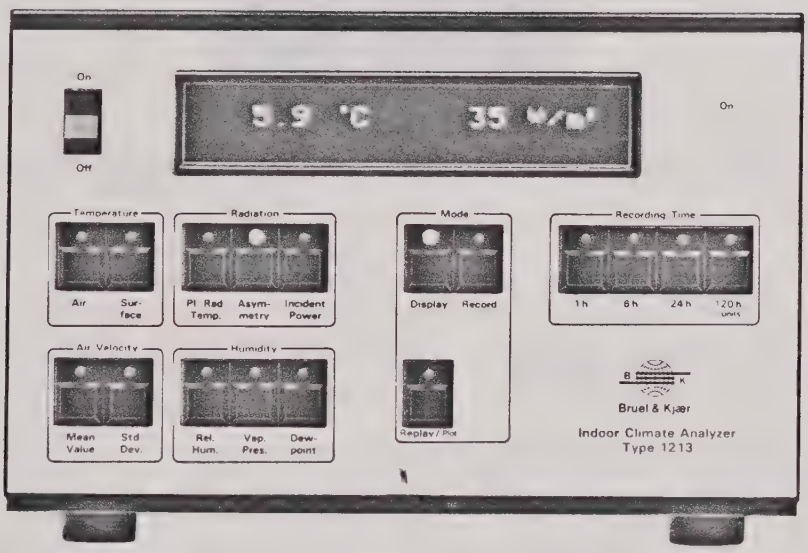


Fig. 2.1. Front panel of Indoor Climate Analyzer Type 1213

The front panel controls of the Type 1213 can be conveniently grouped into five sections as follows:

1. Power switch
2. Transducer selection
3. Mode controls
4. Recording Time controls
5. Display

With the exception of the power switch all controls have green LEDs which are either lit or flash when activated. However, to conserve battery power when recording the Type 1213 also has a low power mode, in which only the "Record" LED is lit. Several operations require the use of combinations of controls.

2.1.1. Power Switch

On - Off: Switch for turning the instrument "On" and "Off". When in the "Off" position data in the memory remains unaffected and is retained.

2.1.2. Transducer Selection

The transducer selection section consists of ten pushkeys which are divided into four groups.

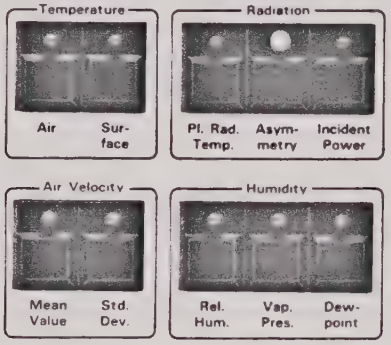


Fig. 2.2. Transducer selection controls of the Indoor Climate Analyzer Type 1213

TEMPERATURE: Two pushkeys with LEDs for selecting either air or surface temperature.

Air: Selects input from the Air Temperature Transducer for measurement, display and recording.

Surface: Selects input from the Surface Temperature Transducer for measurement, display and recording.

RADIATION: Three pushkeys with LEDs for selecting plane radiant temperature, radiant temperature asymmetry and incident radiant power measurements from the Radiant Temperature Asymmetry Transducer input.

Pl. Rad. Temp: Selects plane radiant temperature measurement. The Radiant Temperature Asymmetry Transducer has two identical measuring faces, one labelled "A" and the other "B". Both values of plane radiant temperature are simultaneously measured and displayed.

Asymmetry: Pushkey to calculate the difference between the two measured values of plane radiant temperature providing a measurement of the radiant temperature asymmetry. The displayed value is A – B. The difference between the incident radiant power (the incident power asymmetry) is also displayed.

Note: Pressing the pushkey a second time causes this difference to be displayed as a bar–graph. See Fig. 2.5.

Incident Power: Pushkey to calculate the incident radiant power on each face of the Radiant Temperature Asymmmetry Transducer.

AIR VELOCITY: Two pushkeys with LEDs for selecting mean air velocity and standard deviation measurements.

Mean Value: Two time averaged air velocity values are calculated and displayed. A 5 s exponential average air velocity is shown on the left of the Display and a linear three minute mean value on the right of the Display. The displayed three minute mean value is updated every 10 seconds.

Std. Dev.: A standard deviation for each of the above two mean values is calculated.

HUMIDITY: Three pushkeys with LEDs for selecting dewpoint, vapour pressure and relative humidity measurements.

Dewpoint: Dewpoint is measured with the Humidity Transducer. To avoid a continuous film of dew on the mirror and in order to conserve battery power, the dewpoint is measured every third minute. The last measured value is always displayed.

Vap. Pres.: Vapour pressure is calculated from the latest dewpoint measurement and is measured in kPa.

Rel. Hum.: The relative humidity is calculated from the dewpoint and air temperature measurements. In order to obtain this measurement both the Humidity Transducer and the Air Temperature Transducer must be connected to the Type 1213.

2.1.3. Mode Controls

The Type 1213 has three possible operating modes, these are; "Display", "Record" and "Replay/Plot". A flashing LED indicates that the appropriate pushkey should be activated in order to continue the desired sequence (e.g. the "Record" sequence).

Fig. 2.3. Mode controls of the Indoor Climate Analyzer Type 1213

Display: On switching the Type 1213 "On" the "Display" mode is automatically selected. Data can be displayed upon selection of the appropriate transducer pushkey. The "Display" function can also be used to obtain current data, when the Type 1213 is in the "Record" mode. If the "Display" pushkey is pressed three times in succession while the Type 1213 is in the "Record" mode recording of data will be terminated. The

"Display" pushkey can also be used to obtain a displayed read-out of data stored in the Memory.

Record: Initiates a programming sequence for selecting parameters to be measured and recorded. The Type 1213 automatically divides the selected measurement duration into 60 equal intervals and measurements are made and stored at each interval. For air velocity measurements a 60 s linear average is recorded if a 1 hr recording period is selected, but for all other recording periods the 3 minute linear average is recorded.

When in the "Record" mode, the "Record" pushkey may be used either to put the Type 1213 into a low power mode where most LEDs are extinguished, or it can be used to obtain a display of the elapsed measurement time. These functions alternate each time the "Record" pushkey is activated. The Analyzer automatically reverts to the low power mode if no pushkey has been activated for 4 minutes.

Replay/Plot: Is used to recover stored data from the Type 1213 memory. When pressed, the user is provided with the opportunity to replay stored data either on the Display or via the outputs on the Rear Panel. If the output to the Display is selected, the "Replay/Plot" pushkey is used to step through the data stored in the memory. If the Rear Panel outputs are selected, "Replay/Plot" is used to obtain "Zero" and "Gain" calibration signals for the X–Y Recorder and also to initiate data plotting once the parameters have been selected.

2.1.4. Recording Time Controls

Four pushkeys for the selection of the recording time. One pushkey has the additional function of changing the measurement units from S I to Imperial and *vice versa.*

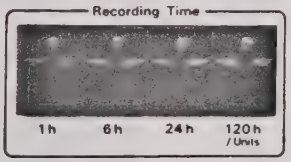


Fig. 2.4. Recording Time controls of the Indoor Climate Analyzer, Type 1213

1 h: Used to select a one hour recording period. When selected, measurements are made every minute. In the "Display" and "Replay/Plot" modes this pushkey is inoperative.

6 h: Used to select a six hour recording period. When selected, measurements are made every six minutes. In the "Display" and "Replay/Plot" modes this pushkey is inoperative.

24 h: Used to select a twenty four hour long recording period. When selected, measurements are made every twenty four minutes. In the "Display" and "Replay/Plot" modes this pushkey is inoperative.

120 h/Units: Used to select a one hundred and twenty hour long recording period. When selected, measurements are made every two hours. In either the "Display" or "Replay/Plot" modes this pushkey can be used to change the measurement units in which the data is displayed from S I to Imperial or *vice versa.*

2.1.5. Display

Fig. 2.5. Display of the Indoor Climate Analyzer Type 1213

Twenty character alphanumeric Display displays measurement data in real–time and can also be used for replaying data stored in the Analyzer Memory. Temperature measurements are displayed to one decimal place and velocity measurements to two decimal places for metric units (integers for °F). All measurements are clearly annotated. The Display also provides information to help in the use of the instrument.

2.2. REAR PANEL

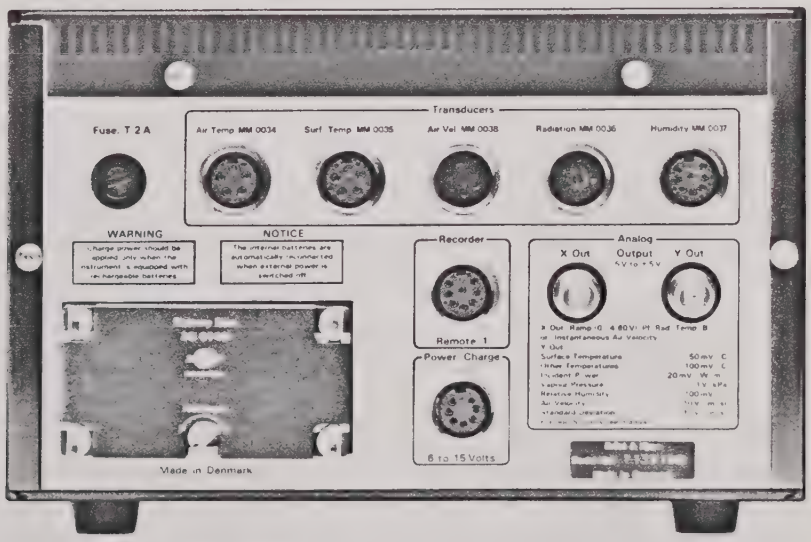


Fig. 2.6. Rear Panel of Indoor Climate Analyzer Type 1213

TRANSDUCERS: Five input sockets for connection of Transducers to the Type 1213. Different types of socket are used in order to prevent the Transducers from being connected incorrectly.

Air Temp. MM 0034: 4-pin socket for connection of the Air Temperature Transducer MM 0034. A MM 0035 Surface Temperature Transducer can be connected to this socket in place of the Air Temperature Transducer.

Surf. Temp. MM 0035: 4-pin socket for connection of the Surface Temperature Transducer MM 0035. The electrical connections for this socket are similar to Air Temp. MM 0034 and thus this socket can also be used to connect a second Air Temperature Transducer in place of the Surface Temperature Transducer. This enables simultaneous measurement of air temperature in two places to be obtained (for example at two different heights).

Air Vel. MM 0038: 6-pin socket for connection of the Air Velocity Transducer MM 0038 to the Type 1213.

Radiation MM 0036: 12-pin socket for connection of the Radiant Temperature Asymmetry Transducer MM 0036 to the Type 1213.

Humidity MM 0037: 8-pin socket for connection of the Humidity Transducer MM 0037 to the Type 1213.

ANALOG OUTPUT: Two BNC sockets accepting plug JP 0035 for connection of an X–Y Recorder, Level Recorder, etc. The outputs obtainable together with voltage scalings are given in Table 2.1.

Analog Output	Parameter	Output Voltage	
		S.I. Units	Imperial Units
X-Out	Ramp	0 – 4,8 V	0 – 4,8 V
X-Out	Pl. Radiant Temperature (B)	100 mV/°C	50 mV/°F
X-Out	Instantaneous Air Velocity[c]	10 V/(m/s)	50 mV/(ft/min.)
Y-Out	Surface Temperature	50 mV/°C	25 mV/°F
Y-Out	Air temperature	100 mV/°C	50 mV/°F
Y-Out	Dew Point	100 mV/°C	50 mV/°F
Y-Out	Incident Power	20 mV/(W/m^2)[a]	mV/(Btu/ft^{2}h)[b]
Y-Out	Plane Radiant Temperature (A)	100 mV/°C	50 mV/°F
Y-Out	Vapour Pressure[c]	1 V/kPa	1 V/kPa
Y-Out	Relative Humidity[c]	100 mV/%	100 mV/%
Y-Out	Air Velocity[c]	10 V/(m/s)	50 mV/(ft/min.)
Y-Out	Standard Deviation	10 V/(m/s)	50 mV/(ft/min)

a) –9 V offset b) –7,5 V offset c) –5 V offset T00635GB0

Table 2.1. Voltage outputs for the different parameters measured by the Indoor Climate Analyzer (in DISPLAY mode)

RECORDER: 8-pin socket accepting plug JP 0802 or Control Cable AQ 0034 for connection to X–Y Recorder Type 2308. Electrical connections are shown in Figure 2.7.

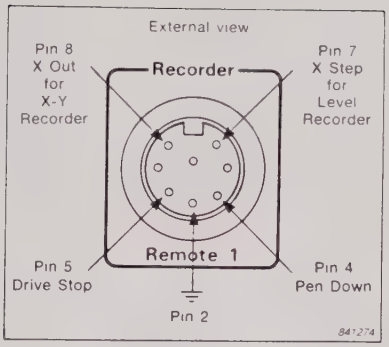


Fig. 2.7. External view of RECORDER socket of Indoor Climate Analyzer Type 1213

POWER/CHARGE:

Socket with screw lock accepting standard 7-pin DIN plug JP 0703 or JP 0710 (with screw-locking collar). For recharging Ni–Cd batteries if these are installed in place of the alkaline cells supplied, and/or powering the instrument whether or not batteries are installed. The connections are shown in Fig. 2.8.

⚠ **WARNING!** — Before attempting to recharge cells in battery compartment, ensure that rechargeable batteries are installed.

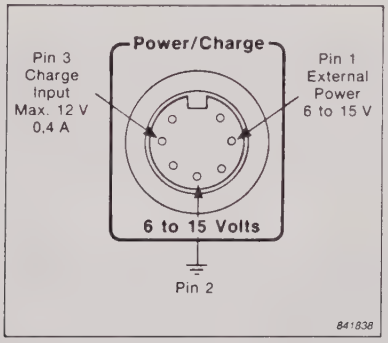


Fig. 2.8. External view of the POWER/CHARGE socket of Indoor Climate Analyzer Type 1219

SUPPLY COMPARTMENT:

Accepts Battery Box ZG 0146 (supplied) or Mains Power Supply ZG 0199 (optional accessory) for powering the instrument. Read the power supply instructions in Section 3.1.3 before attempting to use the Indoor Climate Analyzer.

FUSE:

Fuse-holder accepting 2 A slow-blow fuse (B & K No. VF 0010) to IEC 127 III. See section 3.2.

3. OPERATION

3.1. PRELIMINARY

3.1.1. Environment and Handling

The Indoor Climate Analyzer Type 1213 is a readily transportable instrument designed to operate in a temperature range of between +5° to +40°C (+41° to +104°F) and may be operated in conditions of up to 90% relative humidity (non-condensing) at 30°C. All Transducers can be operated in ambient temperatures down to 0°C (32°F), while the Air and Surface Temperature Transducers can be operated in ambient temperatures down to −20°C (−4°F).

Other than observance of the instructions relating to power sources, no special handling precautions are necessary for the Type 1213 itself. However the Transducers should be treated with care and kept in the Transducer Carrying Case KE 0234 when they are not in use.

The validity of humidity measurements obtained using the Humidity Transducer MM 0037 are dependent on the mirror surface within the Transducer being kept clean. For this reason the mirror is enclosed in a protective shield. However, from time to time the mirror surface should be checked and if necessary carefully cleaned using a soft cloth and alcohol. After cleaning ensure that all the cleaning agent has been removed before taking any measurements.

Radiant temperature measurements may also be adversely affected by dust or other dirt. For this reason the surfaces of the Radiant Temperature Asymmetry Transducer MM 0036 are enclosed within thin polyethelyne Radiation Transparent Windshields, which also provides protection from air velocity fluctuations. These Windshields should be replaced when they become scratched or dirty. A set of 16 Windshields UA 0851 is supplied with the Radiant Temperature Asymmetry Transducer and further sets may be obtained.

3.1.2. Mounting

The 1213 may be used free-standing on its four plastic feet or tilted by means of the metal stand attached to the front pair of feet. The instrument should be kept well away from the Transducers during measurements so that the operator's presence does not influence the measurements.

The Analyzer is also designed to fit into the standard 19-inch B & K Module System. For further details consult the B & K product data sheet on Cassette, Cabinet and Combining Systems.

3.2. POWER SUPPLY

The available options for powering the Analyzer are as follows:

1. Battery Box ZG 0146 plus six alkaline batteries QB 0004 (Type IEC LR20). Operating life sufficient for 8 hours in normal operation. A 24 hour recording is also possible, provided "low power" mode is used.

2. Battery Box ZG 0146 plus six rechargeable NiCd cells QB 0008. These can be recharged up to 500 times. Operating life for each full charge is sufficient for 6 hours in normal operation. Battery Charger ZG 0113 is available as an option.

3. Mains Power Supply ZG 0199 installed in Supply Compartment.

4. Mains Power Supply ZG 0199 used externally, via the POWER/CHARGE socket.

5. External DC supply with rating 6 V to 15 V DC and 1 A, via the POWER/CHARGE socket.

3.2.1. Batteries

The Indoor Climate Analyzer is supplied with six Alkaline Batteries (QB 0004). Replacement cells may be ordered from B & K, or other cells of the same size may be used. The use of non-alkaline dry cells is not recommended, because of the risk of damage to the Battery Box and the Analyzer caused by chemical action in such cells after they are exhausted. Rechargeable NiCd cells (QB 0008) may also be installed in the Battery Box.

3.2.2. Installation of Batteries

1. Access to the Battery Box is on the Rear Panel of the Analyzer. To insert or replace cells in the Battery Box, first remove the Box from the Supply Compartment of the Analyzer by turning the "Release" screw with a screwdriver.

2. Unlock the 4 fastening screws on the lid of the Battery Box. Remove lid and slide out the used cells.

3. Load the six replacement cells into the Box, in pairs as shown in Fig. 3.1, taking care to place each cell the correct way round. There are arrows marked inside the Box indicating in which direction the positive stud of the cells should point.

4. Replace the lid of the Battery Box and lock it by turning the fastening screws at each corner of the lid by half a turn.

5. Label the lid to indicate whether the cells are rechargeable or not.

⚠ **WARNING:** It is possible for cells to explode if they are abused, so NEVER —

(a) attempt to recharge non-rechargeable cells;
(b) attempt to recharge cells the wrong way round;
(c) mix different makes or types of cells in one Battery Box;
(d) mix discharged cells with charged cells.

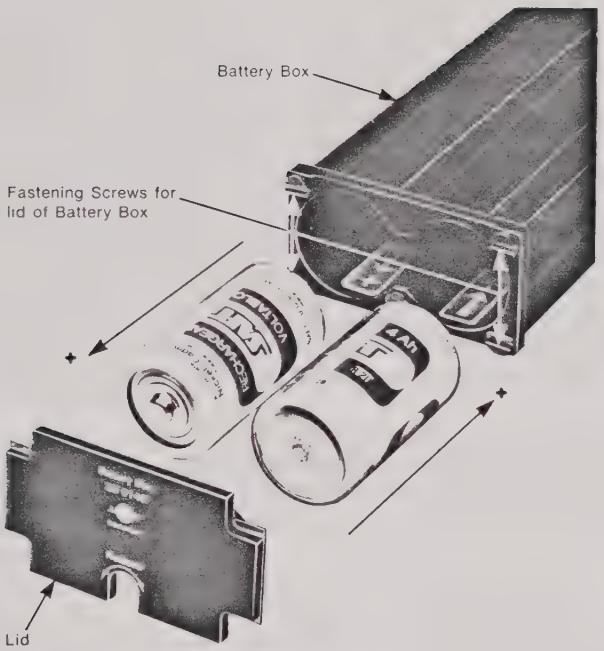


Fig. 3.1. Fitting batteries into the Battery Box

To install the Battery Box in the Supply Compartment of the Analyzer, proceed as follows, referring to Fig. 3.2:

1. Ensure that the Battery Box is the right way up and slide it into the Supply Compartment of the Analyzer.

2. Press the Battery Box into the Supply Compartment until the "Release" screw can be turned to engage the groove in the locking pin, securing the Battery Box in place.

Fig. 3.2. Fitting Battery Box into Supply Compartment of the Indoor Climate Analyzer

3.2.3. Battery Charger ZG 0113

Rechargeable cells installed in the Battery Box of the Type 1213 may be recharged in-situ using Battery Charger ZG 0113 (Fig. 3.3) or other suitable battery charger. The Battery Charger (available as an optional accessory) is suitable for use with 50 to 400 Hz single-phase AC mains. A mains voltage range of either 100 to 130 V or 200 to 240 V may be selected by the choice of colour-coded conductors in the mains cable. There are three of these conductors, one of which should be cut back. To use the Charger on 100 to 130 V, cut back the brown conductor and connect the supply between the blue and black conductors. To use it on 200 to 240 V, cut back the black conductor and connect the supply between the blue and brown. Connect the 7-pin DIN plug on the Charger to the POWER/CHARGE socket on the Rear Panel of the Type 1213. The ZG 0113 delivers approximately 0,4 A DC when used to recharge QB 0008 cells installed in the Analyzer.

The Analyzer may be used to take measurements while the Charger is connected and supplying current **provided rechargeable cells are installed**. This arrangement can usefully extend the period for which the Analyzer may be operated on its batteries. It must not be used like this with non-rechargeable cells, and it should not be used with no cells installed.

QB 0008 cells take approximately 14 hours to charge at the maximum permitted charging-current (0,4 A) from complete exhaustion to full charge, and proportionately longer at lower charging-currents. No harm will result from continuing to charge these cells after they have become fully charged. However, if the instrument is used only infrequently, frequent unnecessary charging of the cells can shorten their long lifetime.

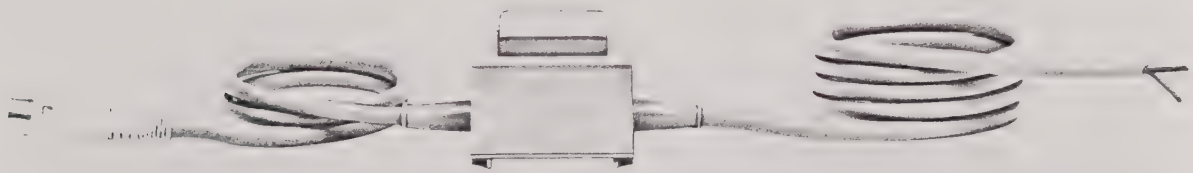


Fig. 3.3. Battery Charger ZG 0113

3.2.4. Mains Power Supply ZG 0199

The Mains Power Supply ZG 0199 (Fig. 3.4), available to order, may either be used fitted inside the Supply Compartment of the Indoor Climate Analyzer, or externally. It may be powered from 50 to 400 Hz single phase AC mains, and when adjusted as described in its Instruction Manual can accept voltages of 100, 115, 127, 220 or 240 V.

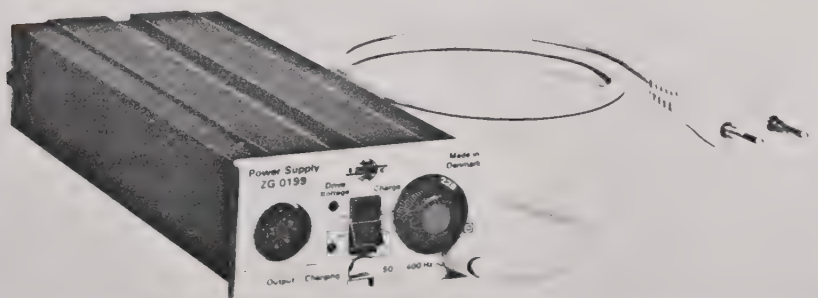


Fig. 3.4. Power Supply ZG 0199 for external use with the Analyzer Type 1213

The procedure for installing the ZG 0199 in the Supply Compartment of the Type 1213 is the same as that described in section 3.2.2 for the Battery Box ZG 0146. Care should be taken to locate the Mains Power Supply the right way up.

To use the ZG 0199 externally for powering the instrument, and/or recharging NiCd cells if they are fitted, connect one end of Control Cable AQ 0035 to the POWER/CHARGE socket on the Rear Panel of the Type 1213, and the other end to the OUTPUT socket on the ZG 0199. The ZG 0199 provides sufficient current to simultaneously recharge cells and to power the instrument.

⚠ **WARNING:** If non-rechargeable cells are fitted in the Battery Box installed in the instrument, the OUTPUT SELECTOR switch on the ZG 0199 must be set to DRIVE VOLTAGE "On" — CHARGE "Off".

To charge rechargeable cells installed in the Type 1213, set OUTPUT SELECTOR on the ZG 0199 to DRIVE VOLTAGE "On" — CHARGE "On". The charge time for completely exhausted cells is approximately 14 hours.

If the ZG 0199 is connected externally to the Type 1213 and switched on, power will automatically be taken from it in preference to any installed batteries.

Note: If batteries are installed, switching off the ZG 0199 will cause the Type 1213 to continue to run from its batteries, unless the Power Switch is turned to the "Off" position.

3.2.5. External DC

An external DC source, such as a car battery, may be used to power the Indoor Climate Analyzer via the POWER/CHARGE INPUT socket on the rear panel. This has the pin connections shown in Fig. 2.8 and accepts the 7-pin DIN plug JP 0710 supplied. The FUSE fitted in the instrument protects it, but it is recommended that the connections from an external source should be protected by a slow-blow fuse or other current-limiting device of not more than 2 A rating.

Pin 1 carries current only to power the Type 1213 (not to charge any fitted batteries). Internal power conditioning permits acceptance of a voltage range of +6 to +15 V DC. The power required will be more or less independent of voltage supplied, so lower voltages will have to deliver more current than higher ones.

Pin 3 carries current to charge fitted batteries, which should therefore be only of rechargeable types if this pin is used. Provided the external supply fulfills the requirements for both charging and powering the instrument (12 V, 1 A), it may be connected to both pins 1 and 3. NiCd rechargeable batteries may be charged via pin 3 from a power supply whose open-circuit voltage exceeds +12 V DC **only if** it is current-limited to not more than 0,4 A. (Current-limiting can easily be achieved by wiring a suitable resistor in series with pin 3). At this current QB 0008 NiCd batteries take approximately 14 hours to receive a full charge.

Pin 2 is common to both charge and power inputs. The battery and external power circuits are completely isolated from the measurement circuits, outputs and all exposed metalwork of the Indoor Comfort Analyzer. This isolation prevents earth-loops occurring when more than one instrument share a common supply source. It is not intended to withstand potentially hazardous voltages.

When using the POWER/CHARGE INPUT socket connected to a vehicle battery, avoid running the engine with only pins 1 and 2 connected, as voltage surges may damage the instrument or cause measurement errors.

3.3. CALIBRATION OF THE INDOOR CLIMATE ANALYZER AND TRANSDUCERS

The Indoor Climate Analyzer Type 1213 and all the Transducers are calibrated during manufacture, and no adjustments by the user are required.

The measurement accuracy of the Analyzer stated under "Specifications" in Chapter 1 is the sum of the separate tolerances of the electronic measuring circuits and the various Transducers. These tolerances are small enough to ensure mutual interchangeability between all manufactured samples of the Analyzer and the Transducers.

3.4. OPERATION OF THE INDOOR CLIMATE ANALYZER

This section describes how to use the Type 1213 for taking measurements of the indoor thermal environment. Additional information dealing with theoretical and background information about measurements, and applications literature, can be supplied on request by B & K representatives. Before use the Type 1213 should be provided with a suitable source of power as described in section 3.2.

3.4.1. Setting up the Transducers

Up to five different Transducers can be connected to the Indoor Climate Analyzer Type 1213 at the same time. These Transducers (Figs. 2 to 6 in Chapter 1) measure different parameters which can be used to describe and investigate an indoor thermal environment.

The Transducers should be connected to their respective sockets on the Rear Panel of the Analyzer. With the exception of the Air Temperature Transducer MM 0034 and the Surface Temperature Transducer MM 0035, the Transducers have different plugs making connection to the wrong sockets impossible. The Air Temperature Transducer and Surface Temperature Transducer have identical plug and socket connections allowing interchangeability. Thus, either two Air Temperature or two Surface Temperature Transducers can be connected simultaneously to the Analyzer.

It is important that the Transducers are positioned as far away from the Analyzer as practicable so that the influence of the operator on the environment being measured is minimised.

In order to comply with standards relating to environmental measurements, measurements should be conducted at various heights above the ground (see Table 3.1).

Position of the sensors	Recommended* heights above ground (for guidance only)	
	Sitting	Standing
Head level	1,1 m	1,7 m
Abdomen level	0,6 m	1,1 m
Ankle level	0,1 m	0,1 m

* ISO/DIS 7726

T00649GB0

Table 3.1. Recommended measurement heights for mounting the Transducers

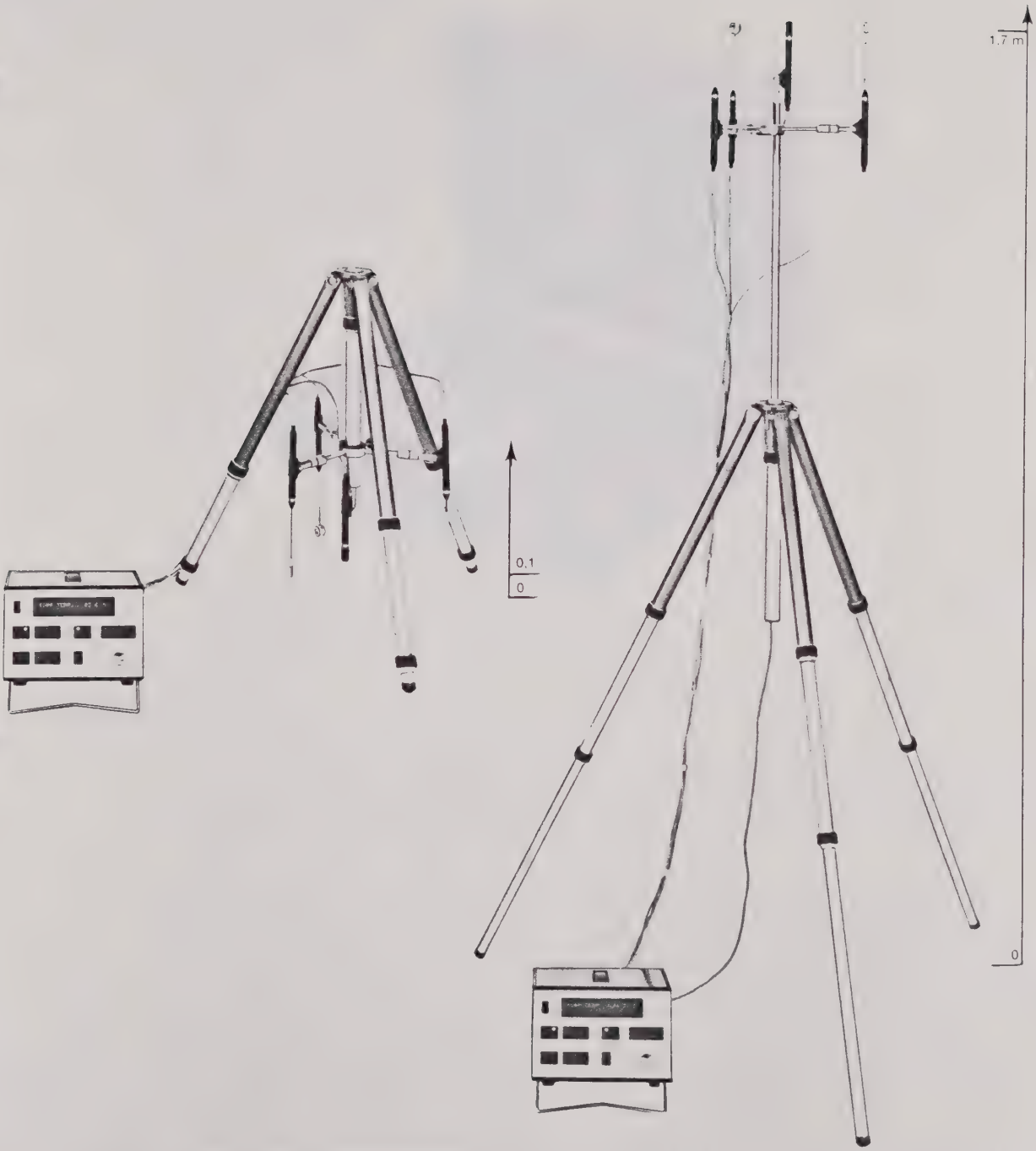


Fig. 3.5. Setting up Transducers at recommended heights using Tripod UA 0801, Delta Arm DH 0492 and four Tripod Adaptors UA 0588

Correct positioning of the Transducers can be achieved using a Tripod, such as UA 0801 which can be obtained to order. A special Delta Arm DH 0492 can also be obtained, which, together with four Tripod Adaptors UA 0588 enables up to four Transducers to be mounted on the same Tripod (Fig. 3.5). The Delta Arm, Tripod Adaptors and Transducers are supplied in a specially designed robust Carrying Case KE 0234 when the Indoor Climate Analyzer Measuring Set Type 3532 is ordered (Fig. 3.6).

Fig. 3.6. Carrying Case KE 0234 containing 5 Transducers, Delta Arm DH 0492 and Tripod Adaptors UA 0588

3.4.2. The Self-Test Routine

Each time the Indoor Climate Analyzer Type 1213 is switched "On", a short self-test routine is automatically initiated. During this test --- TESTING --- is displayed. Provided that no faults are detected during the self-test routine SELECT TRANSDUCER appears on the Display on completion of the routine.

The self-test routine checks the operation of basic functions such as the A/D conversion, validity of the program in the Read Only Memory (ROM) and the functioning of the Random Access Memory (RAM) for data storage. Should a fault be discovered during the self-test program, an error message such as RAM ERROR appears on the Display. Several other error messages may be obtained and the user should refer to the separate Service Manual or local B & K representative for further details. If an error message appears the Analyzer should be switched off immediately and all sources of power removed. The Analyzer should then be serviced before it is used again. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instruments.

3.4.3. Selection of Measurement Units

The Indoor Climate Analyzer is preset for automatic selection of S.I. units. Measurements can however, also be displayed* and output in Imperial units by pressing the "120 h/Units" pushkey. Pressing this pushkey a second time changes the measurement units back to S I

* It is not possible to obtain a radiant temperature asymmetry bar-graph display in Imperial units.

3.5 OPERATING MODES

Control of the Indoor Climate Analyzer is achieved using the pushkeys on the front panel of the instrument. In many circumstances the desired operation can be achieved by activating a single pushkey. However, in some circumstances a sequence of pushkeys must be activated. Flow charts showing these pushkey sequences are given in Figs. 3.7 to 3.10. The operation of the instrument is further explained in the following sections. Further details regarding specific types of measurement are given in Chapter 4, and connection to other B & K instruments for graphical recording are given in Chapter 5.

The Type 1213 has three different operating MODEs:
"Display"
"Record"
"Replay/Plot"

Each operating MODE can be selected by pressing the appropriate pushkey and a Light Emitting Diode (LED) in the pushkey indicates the current MODE of the Analyzer.

3.5.1. Display

The "Display" mode is selected automatically whenever the Analyzer is switched "On". This mode is used for obtaining displays of the last measured data obtained from the various Transducers. The "Display" mode can also be operated while the Analyzer is in the "Record" mode, without affecting the data being stored in the Analyzer Memory. For details of pushkey sequences see Fig. 3.7.

While in "Display" mode, measurements of physical parameters can be displayed by pressing the appropriate parameter pushkey. If a parameter pushkey is selected and the requisite Transducer is not connected, the message CONNECT TRANSDUCER will appear on the Display.

Note: For measurement of Relative Humidity it is necessary to connect both the Air Temperature Transducer MM 0034 and the Humidity Transducer MM 0037.

The "Display" mode can be used to obtain displays of measurements of the various physical parameters as soon as they are obtained by the Analyzer. In most cases the measurement appears on the Display as soon as the relevant pushkey is depressed. However, a short delay will occur if either the AIR VELOCITY or HUMIDITY pushkeys are activated immediately after the initial self-test routine. During this delay the message MEASURING appears. This message is replaced as soon as the first measurement has been completed (see Chapter 4 for further details). Subsequent selection of either the AIR VELOCITY or HUMIDITY pushkeys provides an instantaneous display of the last measured value. If the Analyzer is unable to accurately determine a dew point measurement, the measured value will be displayed alternating with the message DEWPOINT UNSTABLE. If another parameter pushkey is not activated, this type of Display will persist for up to 3 minutes until a new measurement of the dewpoint is obtained.

It is also possible to obtain instantaneous air velocity measurements in the "Display" mode, via the X–output on the Rear Panel of the Analyzer (see Chapter 5).

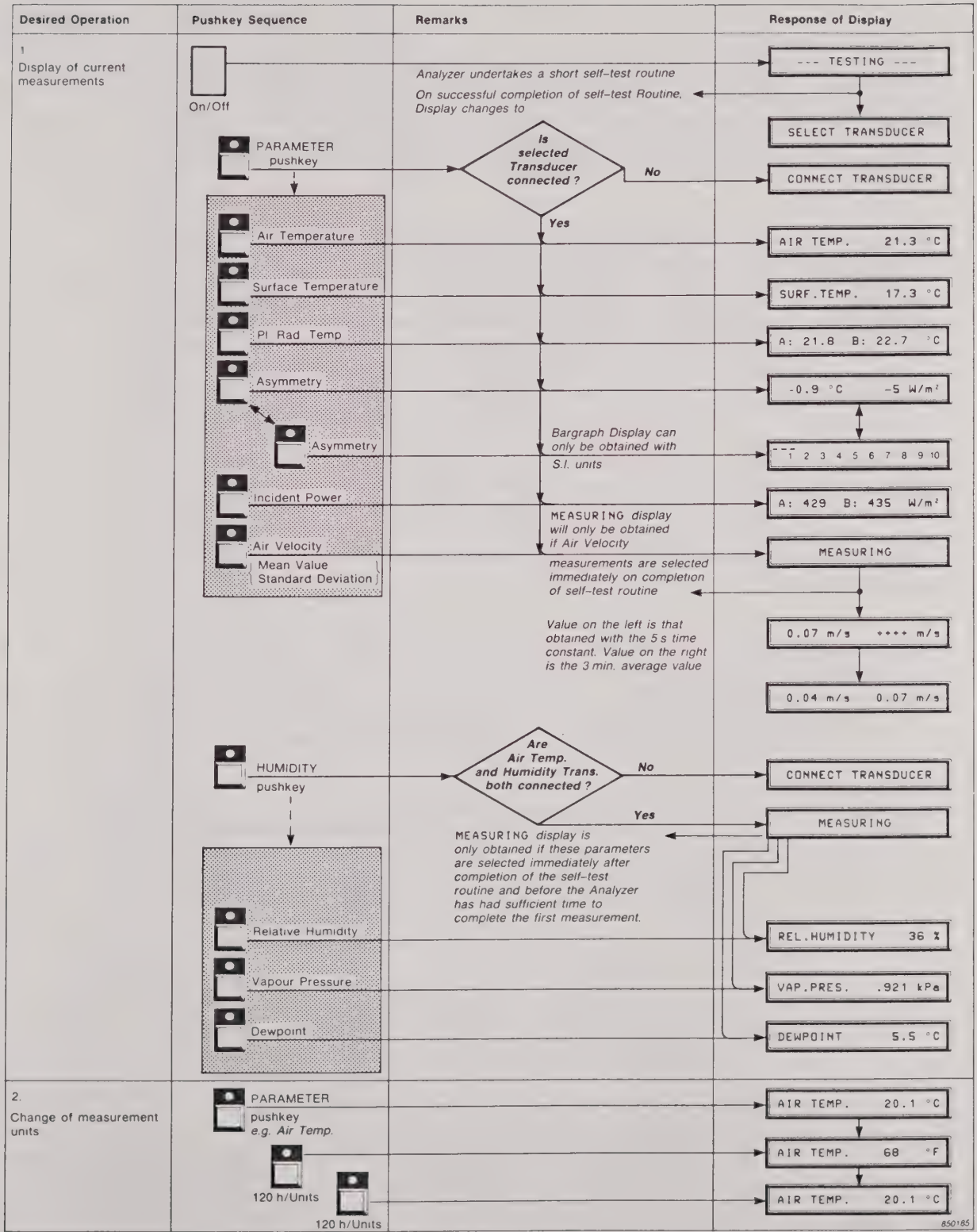

Desired Operation
Pushkey Sequence
Remarks
Response of Display
1
Display of current measurements
On/Off
Analyzer undertakes a short self-test routine
On successful completion of self-test Routine, Display changes to
--- TESTING ---
SELECT TRANSDUCER
PARAMETER pushkey
Is selected Transducer connected ?
No
CONNECT TRANSDUCER
Yes
Air Temperature
AIR TEMP. 21.3 °C
Surface Temperature
SURF.TEMP. 17.3 °C
Pl Rad Temp
A: 21.8 B: 22.7 °C
Asymmetry
-0.9 °C -5 W/m²
Asymmetry
Bargraph Display can only be obtained with S.I. units
1 2 3 4 5 6 7 8 9 10
Incident Power
A: 429 B: 435 W/m²
Air Velocity
MEASURING display will only be obtained if Air Velocity
MEASURING
Mean Value
Standard Deviation
measurements are selected immediately on completion of self-test routine
Value on the left is that obtained with the 5 s time constant. Value on the right is the 3 min. average value
0.07 m/s ++++ m/s
0.04 m/s 0.07 m/s
HUMIDITY pushkey
Are Air Temp. and Humidity Trans. both connected ?
No
CONNECT TRANSDUCER
Yes
MEASURING
MEASURING display is only obtained if these parameters are selected immediately after completion of the self-test routine and before the Analyzer has had sufficient time to complete the first measurement.
Relative Humidity
REL.HUMIDITY 36 %
Vapour Pressure
VAP.PRES. .921 kPa
Dewpoint
DEWPOINT 5.5 °C
2.
Change of measurement units
PARAMETER pushkey e.g. Air Temp.
AIR TEMP. 20.1 °C
120 h/Units
AIR TEMP. 68 °F
120 h/Units
AIR TEMP. 20.1 °C
850185

Fig. 3.7. Pushkey sequences for operation of Indoor Climate Analyzer in "Display" Mode

3.5.2. Record

The Indoor Climate Analyzer can store 60 measurements of each preselected parameter in its internal memory. These data can be stored for up to five years, and will not be lost when the Analyzer is switched "Off" or the power supply disconnected. Thus, data can be conveniently collected during on-site measurements and analyzed when the instrument is returned to the laboratory. The memory is powered by an internal lithium battery.

Details of the pushkey sequences and operation of the Analyzer in the "Record" mode are shown in Fig. 3.8. In order to commence recording and storing data in the Analyzer memory the "Record" pushkey must be activated. This produces the message SELECT TRANSDUCERS on the Display. The user then selects the parameters to be recorded by pressing the appropriate PARAMETER pushkeys. Provided that all five Transducers are connected to the Analyzer, simultaneous recording of all measurements is possible. Should a parameter pushkey be activated when the appropriate Transducer is not connected, the message CONNECT TRANSDUCER will appear on the Display. Pressing the parameter pushkey once more will cancel the requested recording.

Once the measurement parameters have been selected, the operator must select a measurement period over which recording of data will take place. Four different recording times are available (1, 6, 24 and 120 hours) and measurements are recorded at equal intervals throughout the measurement period. Thus, for a 6 hour measurement period data are recorded every 6 minutes. These measurements may be made in the one location or the transducers may be moved to different locations in the interval between measurements.

The recording period begins when the "Record" pushkey is activated for the second time. This also transfers the Analyzer to a lower power mode, which is characterised by a blank Display and all LED's except the "Record" LED being extinguished. This low power mode reduces the power consumption of the Analyzer and enables a 24 hour recording to be made using one set of fully charged alkaline batteries.

It is still possible to obtain real time measurements on the Analyzer Display whilst the Type 1213 is in the "Record" mode. To reactivate the Display the "Display" pushkey should be pressed. Individual measurements can then be read from the Display by pressing the appropriate parameter pushkeys in the same way as when the Analyzer is in the normal "Display" mode. If the Analyzer is left for about four minutes without any pushkeys being activated, it will automatically return to the low power mode.

Once the measurement period has been completed the LED in the "Record" pushkey flashes.

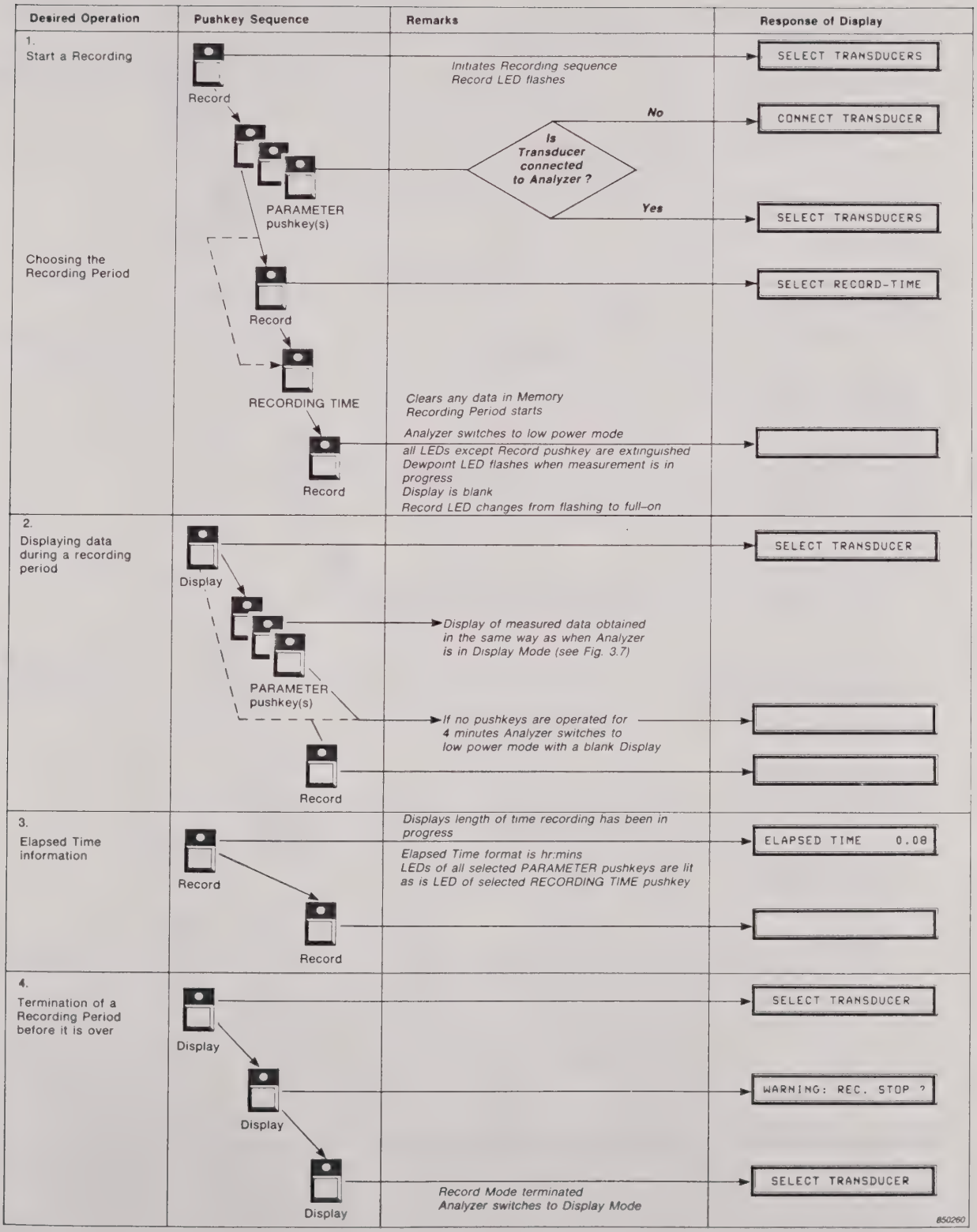


Fig. 3.8. Pushkey sequences for operation of Indoor Climate Analyzer in "Record" Mode

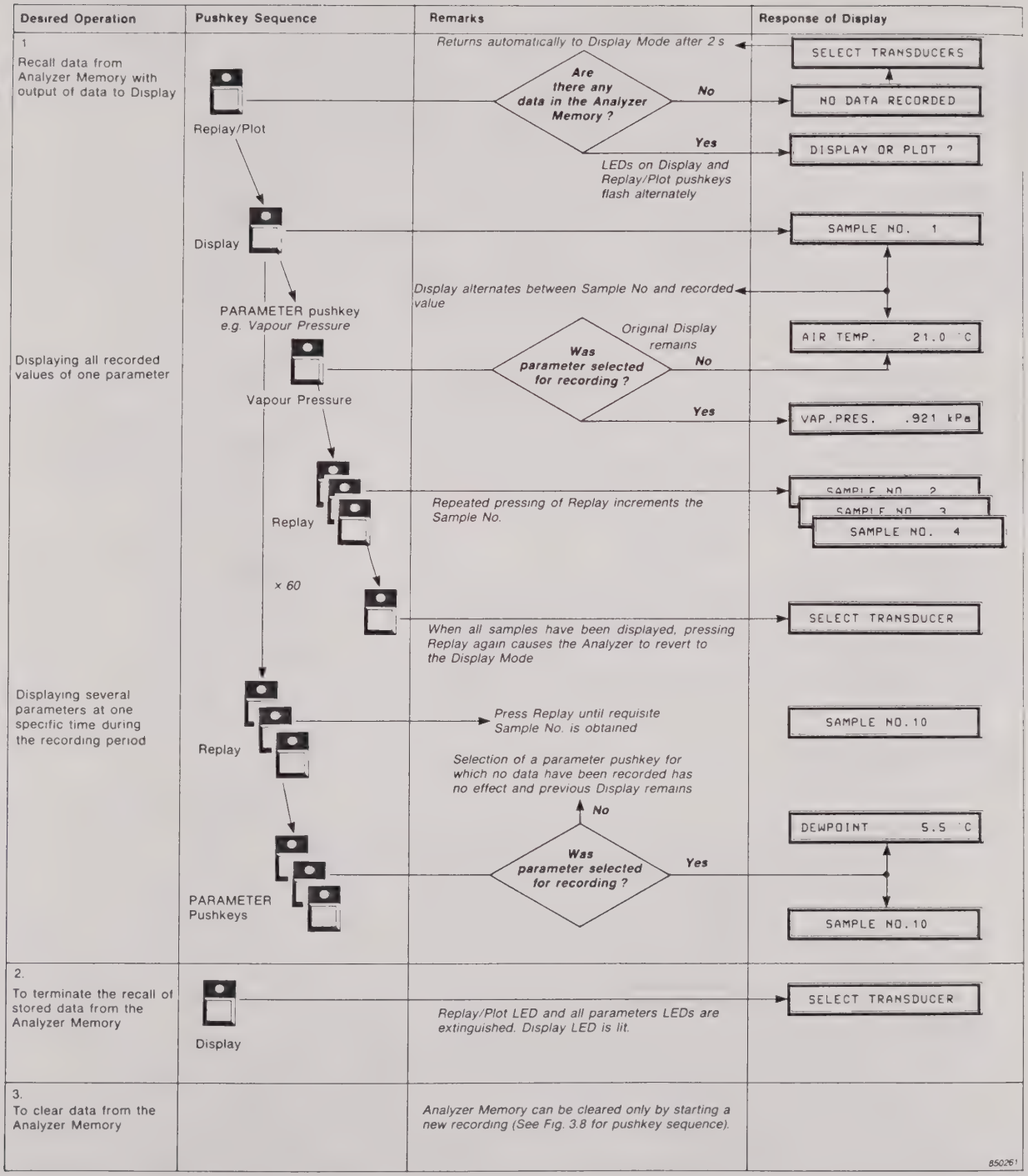

Desired Operation
Pushkey Sequence
Remarks
Response of Display
1
Recall data from Analyzer Memory with output of data to Display
Displaying all recorded values of one parameter
Displaying several parameters at one specific time during the recording period
2.
To terminate the recall of stored data from the Analyzer Memory
3.
To clear data from the Analyzer Memory
Replay/Plot
Display
PARAMETER pushkey
e.g. Vapour Pressure
Vapour Pressure
Replay
× 60
Replay
PARAMETER
Pushkeys
Display
Returns automatically to Display Mode after 2 s
Are there any data in the Analyzer Memory ?
No
Yes
LEDs on Display and Replay/Plot pushkeys flash alternately
Display alternates between Sample No and recorded value
Original Display remains
Was parameter selected for recording ?
No
Yes
Repeated pressing of Replay increments the Sample No.
When all samples have been displayed, pressing Replay again causes the Analyzer to revert to the Display Mode
Press Replay until requisite Sample No. is obtained
Selection of a parameter pushkey for which no data have been recorded has no effect and previous Display remains
No
Was parameter selected for recording ?
Yes
Replay/Plot LED and all parameters LEDs are extinguished. Display LED is lit.
Analyzer Memory can be cleared only by starting a new recording (See Fig. 3.8 for pushkey sequence).
SELECT TRANSDUCERS
NO DATA RECORDED
DISPLAY OR PLOT ?
SAMPLE NO. 1
AIR TEMP. 21.0 °C
VAP.PRES. .921 kPa
SAMPLE NO. 2
SAMPLE NO. 3
SAMPLE NO. 4
SELECT TRANSDUCER
SAMPLE NO.10
DEWPOINT 5.5 °C
SAMPLE NO.10
SELECT TRANSDUCER
B50261

Fig. 3.9. Pushkey sequences for operation of Indoor Climate Analyzer in "Replay" Mode using the Display on the Analyzer

3.5.3. Replay/Plot

Data stored in the Memory of the Analyzer can be replayed for plotting onto Recorders such as the Type 2308 via the outputs on the Rear Panel. Alternatively, the data in the Memory can be reviewed using the Display of the Analyzer. The pushkey sequences for the replaying or plotting of data are shown in Figs. 3.9 and 3.10.

To obtain the data stored in the Analyzer Memory the operator selects the "Replay/Plot" pushkey. This produces a DISPLAY OR PLOT ? message on the Analyzer Display. At the same time the LEDs on the "Display" and "Replay/Plot" pushkeys flash alternately. If the data is to be replayed on the Display, the "Display" pushkey should be activated (see Fig. 3.9). To obtain the data via the Rear Panel outputs the "Replay/Plot" pushkey should be activated (see Fig. 3.10 and also Chapter 5).

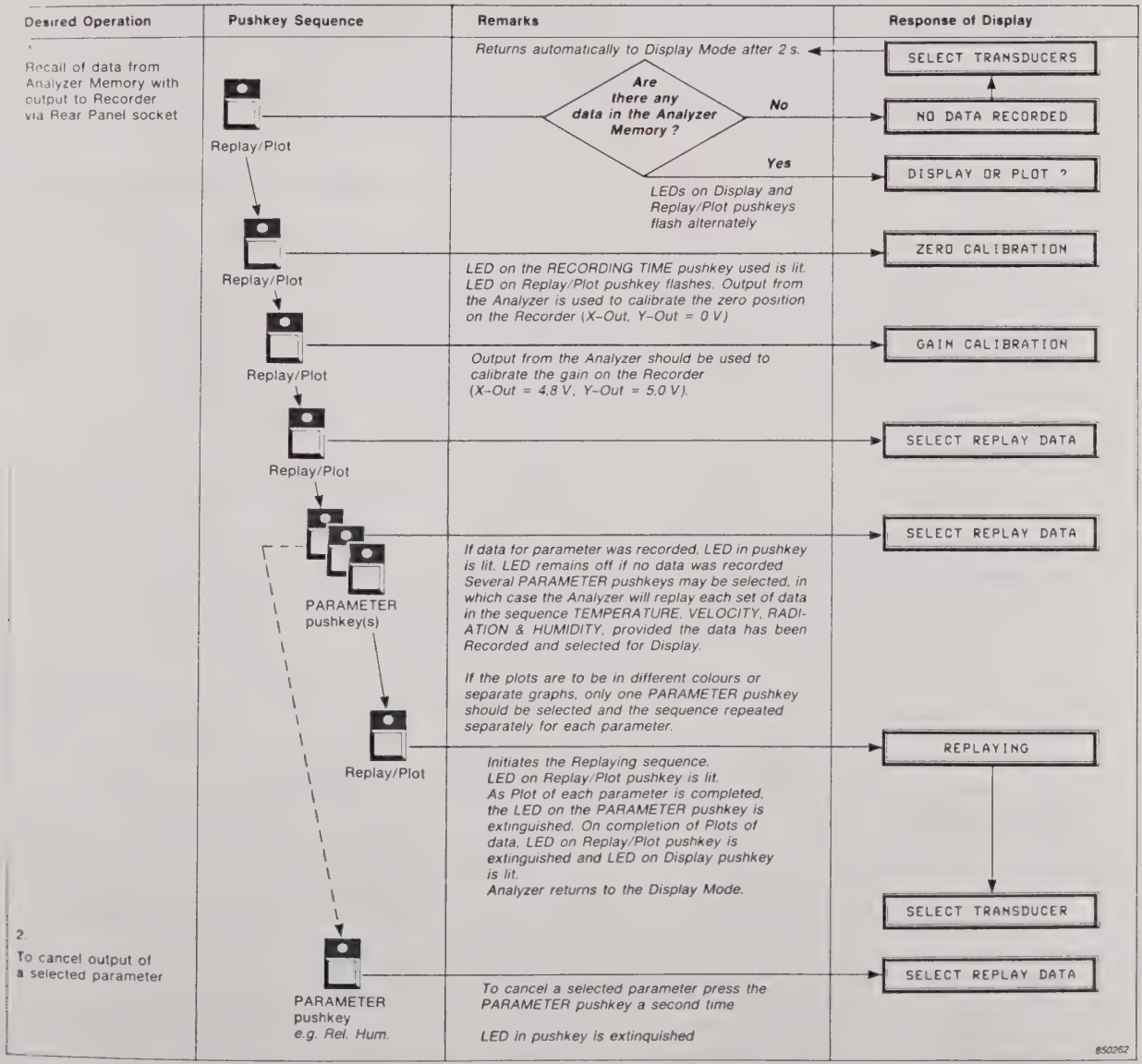

Desired Operation
Pushkey Sequence
Remarks
Response of Display
1.
Recall of data from Analyzer Memory with output to Recorder via Rear Panel socket
Returns automatically to Display Mode after 2 s.
SELECT TRANSDUCERS
Are there any data in the Analyzer Memory ?
No
NO DATA RECORDED
Replay/Plot
Yes
DISPLAY OR PLOT ?
LEDs on Display and Replay/Plot pushkeys flash alternately
Replay/Plot
ZERO CALIBRATION
LED on the RECORDING TIME pushkey used is lit. LED on Replay/Plot pushkey flashes. Output from the Analyzer is used to calibrate the zero position on the Recorder (X-Out, Y-Out = 0 V)
Replay/Plot
GAIN CALIBRATION
Output from the Analyzer should be used to calibrate the gain on the Recorder (X-Out = 4,8 V, Y-Out = 5,0 V).
Replay/Plot
SELECT REPLAY DATA
PARAMETER pushkey(s)
SELECT REPLAY DATA
If data for parameter was recorded, LED in pushkey is lit. LED remains off if no data was recorded Several PARAMETER pushkeys may be selected, in which case the Analyzer will replay each set of data in the sequence TEMPERATURE, VELOCITY, RADIATION & HUMIDITY, provided the data has been Recorded and selected for Display.
If the plots are to be in different colours or separate graphs, only one PARAMETER pushkey should be selected and the sequence repeated separately for each parameter.
Replay/Plot
REPLAYING
Initiates the Replaying sequence.
LED on Replay/Plot pushkey is lit.
As Plot of each parameter is completed, the LED on the PARAMETER pushkey is extinguished. On completion of Plots of data, LED on Replay/Plot pushkey is extinguished and LED on Display pushkey is lit.
Analyzer returns to the Display Mode.
SELECT TRANSDUCER
2.
To cancel output of a selected parameter
PARAMETER pushkey e.g. Rel. Hum.
To cancel a selected parameter press the PARAMETER pushkey a second time
LED in pushkey is extinquished
SELECT REPLAY DATA
850262

Fig. 3.10. Pushkey sequences for operation of Indoor Climate Analyzer in "Replay" Mode using the Rear Panel outputs on the Analyzer

4. MEASUREMENTS USING THE INDOOR CLIMATE ANALYZER

4.1. INTRODUCTION

The Indoor Climate Analyzer enables measurement to be made of the environmental factors to which an individual is exposed whilst working in moderate indoor environments. Guidance concerning the measurement of the various physical parameters is given below and additional information can also be found in ISO 7726 and ISO 7730 (Moderate Thermal Environments – Determination of the PMV and PPD indices and specification of the conditions for thermal comfort). References and further details on results reported here are contained in B & K *Technical Review*, No. 1-1985.

4.2. AIR TEMPERATURE MEASUREMENTS

Air temperature is the most common parameter used to describe thermal environments. ISO 7726 requires that adequate precautions be taken in the measurement of air temperature in order to reduce the influence of thermal radiation from surrounding surfaces. The MM 0034 Air Temperature Transducer is shielded from radiant heat and complies with the requirements and recommendations of ISO 7726. Thus, extremely accurate measurements of air temperature can be made using MM 0034 Transducers connected to the Indoor Climate Analyzer Type 1213.

4.2.1. Use of the Air Temperature Transducer

To ensure that the effects of radiant heat are minimized, the operator should make sure that the sensor element of the Air Temperature Transducer is not directed towards any known radiant heat source during measurements. Measurement accuracy will also be affected if the Transducer is hand held during the measurements.

4.2.2. Vertical Air Temperature Difference Measurements

In addition to the basic measurement of air temperature, the Indoor Climate Analyzer can be used to measure the vertical air temperature difference. Vertical air temperature gradients give rise to air movements and can result in local thermal discomfort. Thus, larger vertical temperature gradients are likely to cause more dissatisfaction. The increase in % dissatisfied for increasing vertical temperature gradient is shown in Fig. 4.1. ISO 7730 recommends that for a seated person the vertical air temperature difference between 1,1 m and 0,1 m (i.e. head and ankle level) should be less than 3°C (5,5°F).

Although it is possible to make these measurements, one after the other, using one Transducer, it is more convenient to use two Air Temperature Transducers to obtain the measurements simultaneously. A second Air Temperature Transducer MM 0034 can be connected to the Analyzer via the Surface Temperature Transducer input socket on the Rear Panel.

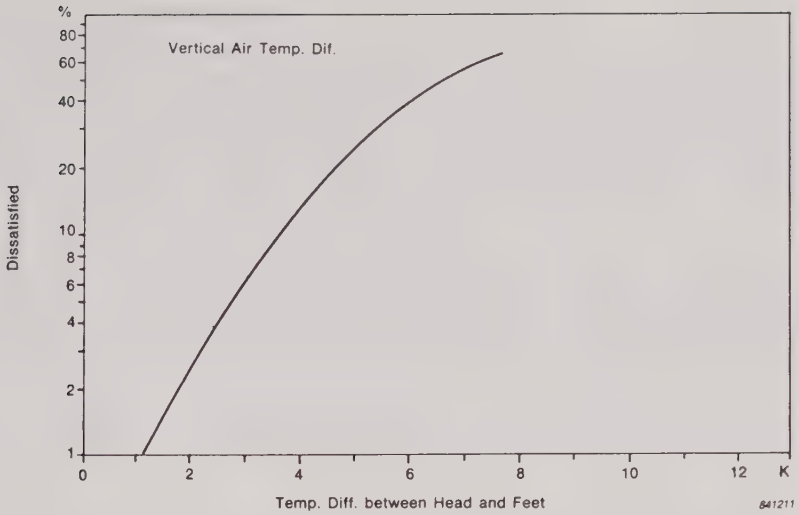


Fig. 4.1. Relationship between Vertical Air Temperature Difference and percentage dissatisfied

Fig. 4.2. Setting up Transducers for measurement of Vertical Air Temperature Difference

4.3. SURFACE TEMPERATURE MEASUREMENTS

The temperature of surfaces such as windows, walls, radiators, etc., influence the environment within a building or vehicle. Hot or cold surfaces can cause air movement or draught and also cause asymmetry within the thermal environment (see also Section 4.6). Thus, although overall or mean values of temperature may lie within the comfort region, hot and/or cold surfaces may be responsible for a greater than expected number of complaints from the individuals within that environment.

ISO 7730 recommends that for environments where people are engaged in light, mainly sedentary activity, the surface temperature of the floor during winter conditions (heating period) should normally be between 19 and 26°C (66 and 79°F). However, for floor heating systems the floor surface temperature may be designed up to 29°C (84°F).

Fig. 4.3 illustrates the relationship between floor temperature and the percentage of people dissatisfied.

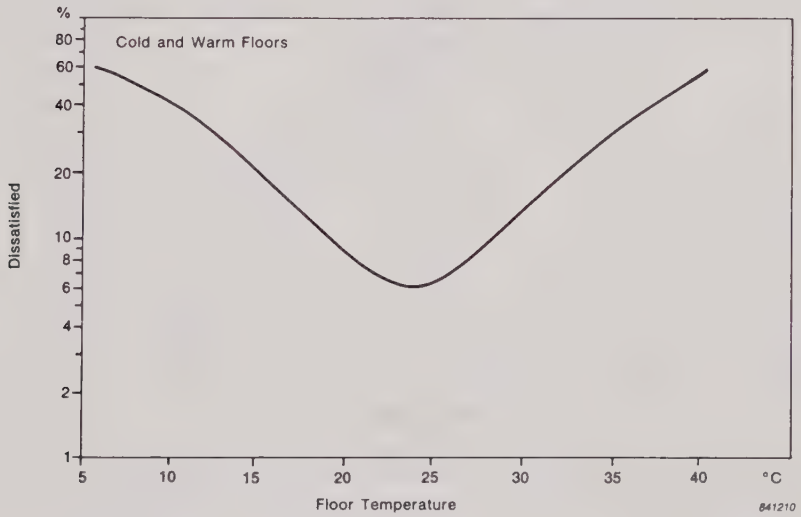


Fig. 4.3. Relationship between Cold and Warm Floors and percentage dissatisfied

4.3.1. Use of the Surface Temperature Transducer

Accurate measurements of surface temperature depend on a good contact between the Transducer and the surface being measured. It is also necessary for the surface to have a high thermal conductivity and to allow a sufficient length of time to elapse for equilibrium to be reached.

When making surface temperature measurements it is good practice to take into consideration the reduction in temperature of the measurement surface caused by the absorbtion of heat by a transducer. The usual procedure is to conduct three measurements very close to one another, allowing each to stabilize before moving the transducer, and taking the last reading to be the true surface temperature.

4. AIR VELOCITY MEASUREMENTS

The movement of air (i.e. draught), particularly when localised, is the most common reason for the discomfort associated with a given environment. There may however, be several causes of such air movements. Because of rapid fluctuations and variations in direction, air velocity is normally difficult to measure accurately, and thus mean values are often used. The relationships between mean air velocity and % dissatisfied at different temperatures is shown in Fig. 4.4.

ISO 7730 recommends that the mean air velocity (over a three minute period) should not exceed 0,15 m/s (29,5 ft/min) in the winter or heating period. This limit may be increased to 0,25 m/s (49 ft/min) in the summer or cooling period. ISO 7726 also recommends that the standard deviation about the mean value should be measured, but no limits for this have been set.

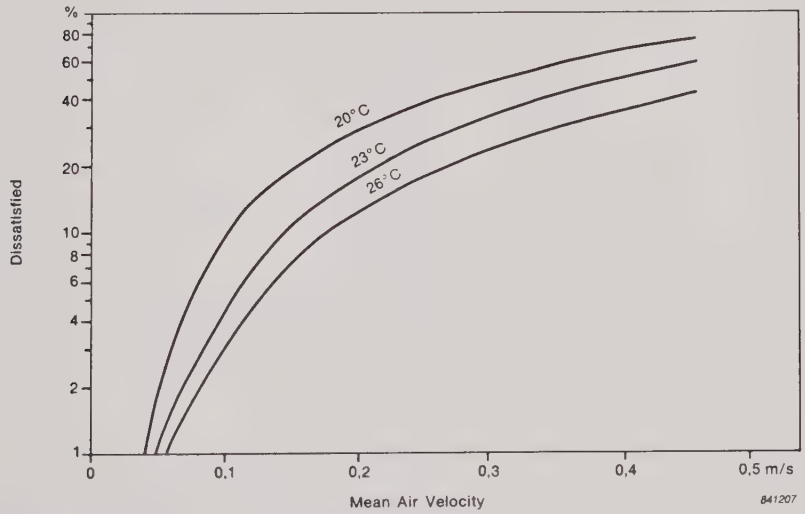


Fig. 4.4. Relationship between Mean Air Velocity and percentage dissatisfied

4.4.1. Use of the Air Velocity Transducer

Five different air velocity measurements can be obtained from the Indoor Climate Analyzer using the Air Velocity Transducer MM 0038. When the Analyzer is in the "Display" mode, activation of the "Mean Value" pushkey produces two values on the Display of the Analyzer. The left–hand value is calculated using a 5 s time constant, which "damps" the fluctuations sufficiently to enable the displayed value to be read by the human eye. A three minute linear mean air velocity value which is updated every 10 s is displayed on the right–hand side of the Display. Activation of the "St. Dev." pushkey also produces a double display of the calculated standard deviations (the "five second" value on the left–hand side and the "three minute" value on the right–hand side of the Display).

In addition to the two displayed air velocity measurements, an instantaneous air velocity measurement on a linear scale can be obtained, by connecting the X-output on the Rear Panel of the Analyzer to a suitable recording device such as a Level Recorder Type 2317 or an X–Y Recorder Type 2308 (see Chapter 5).

In most circumstances air velocity measurements are displayed as soon as the requisite pushkey is activated. However, if an AIR VELOCITY pushkey is activated immediately after the self-test program has been completed a MEASURING message will appear on the Display. As soon as the first 5 s value is obtained the Display changes to give the calculated 5 s value on the left-hand side of the Display. The ++++ m/s on the right-hand side of the Display will be replaced by the 3 minute value as soon as the first measurement of this has been obtained.

The Air Velocity Transducer is an omnidirectional sensor. However, the accuracy of measurements in a 15° solid angle about the handle of the Transducer (see Fig. 4.5) is reduced. Therefore, this solid angle should be oriented away from the direction of any distinctly noticeable air movement. Accuracy of the Air Velocity Transducer will also be reduced if the Transducer is hand–held as opposed to being mounted on a tripod.

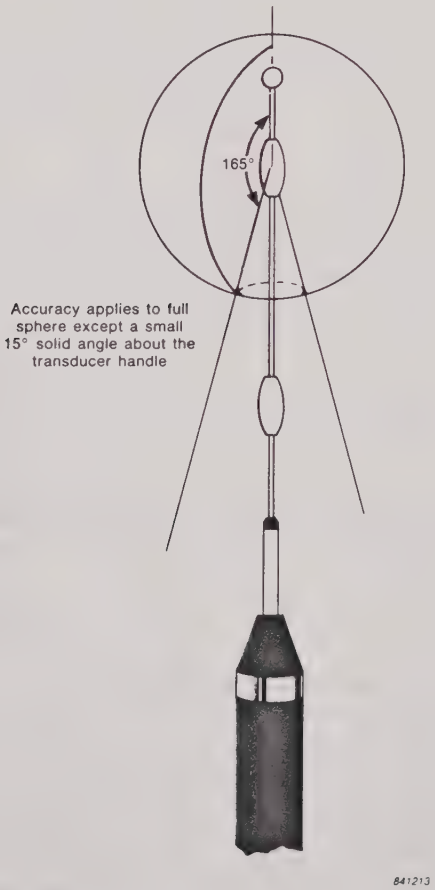


Fig. 4.5. Solid angle about the long axis of the Air Velocity Transducer in which accuracy is reduced

5. HUMIDITY MEASUREMENTS

Several parameters such as dew point, relative humidity, wet and dry bulb temperatures can be used to describe the humidity of an environment. Some definitions of these parameters are given below and the relationship between them is shown in Fig. 4.6.

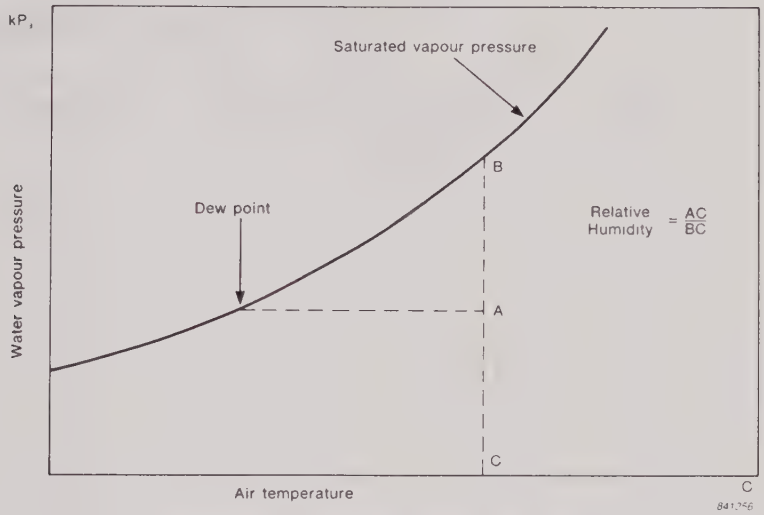


Fig. 4.6. Relationship between various Humidity Parameters

4.5.1. Definition of Humidity Terms

Dew Point: is the temperature at which atmospheric water vapour starts to condense when the air is cooled.

Relative Humidity: is the ratio of the prevailing partial pressure of water vapour to the pressure of saturated water vapour at the prevailing temperature.

4.5.2. Use of the Humidity Transducer

The Humidity Transducer MM 0037 is a dew point temperature measurement system. Other parameters such as vapour pressure and relative humidity are calculated from this measurement. However, if relative humidity measurements are required, it is also necessary to connect the Air Temperature Transducer MM 0034 to the Analyzer.

The MM 0037 Transducer operates on the principle of cooling a mirror to determine the dew point. This technique uses a fairly large amount of power, and for this reason the dew point measurement is updated only every third minute, in order to conserve battery life. However, the last measured value is always displayed by the Analyzer. A flashing LED on the "Dewpoint" pushkey indicates that a measurement is in progress.

If a HUMIDITY pushkey is activated immediately after the self-test program has been completed, MEASURING will first appear on the Display, followed by the first measurement after this has been completed. In some circumstances when the humidity is fluctuating slightly, a stable dewpoint measurement cannot be obtained. Whenever this occurs a reading will still be displayed by the Analyzer, but the measured value will alternate with a DEWPOINT UNSTABLE message. This alternating Display will remain for three minutes until a new HUMIDITY measurement has been obtained.

One possible cause of an unstable dewpoint may be the proximity of the operator or other people. Therefore, care should be taken by the operator to ensure that the Humidity Transducer is positioned as far from people (including the operator) as possible. Additional problems may be caused by the presence of pollutants in the atmosphere which may interfere with the dew formation process.

4.5.3. Accuracy of Humidity Measurements

Air temperature t_a °C	Dewpoint t_d °C	Relative Humidity %	Vapour Pressure kPa
–20	–20*	100	0,13
0	–20*	21	0,13
10	–15	13	0,17
20	–5	17	0,38
30	5	20	0,87
50	25	25	3,18

T00682GB0

* Lower limit for dew point is –20°C

Table. 4.1. Relationship between Dewpoint, Relative Humidity and Water Vapour Pressure for different air temperatures

The range of humidity measurements that can be obtained using the Indoor Climate Analyzer and Humidity Transducer is dependent upon the air temperature as defined by the relationship:

$$t_a - t_d < 25°C$$

where t_a is the air temperature and t_d is the dewpoint.

As there is an absolute lower limit of – 20°C for the dewpoint measurement, the accuracy of the calculation of relative humidity and water vapour pressure is dependent on the dewpoint.

For an air temperature of 20°C, the accuracies stated in Table 4.2 can be obtained with an accuracy between ± 0,5°C and ± 1,0°C for the dewpoint measurement.

Dewpoint t_d °C	Relative Humidity %	Vapour Pressure kPa
–5	17 ± 1	0,40 ± 0,04
0	26 ± 2	0,61 ± 0,04
5	37 ± 3	0,87 ± 0,06
10	52 ± 3	1,23 ± 0,06
15	73 ± 3	1,71 ± 0,06

T00684GB0

Table. 4.2. Accuracy of Relative Humidity and Water Vapour Pressure measurements for different dewpoints

4.6. RADIANT TEMPERATURE MEASUREMENTS

Different measures of radiant temperature can be obtained using the Radiant Temperature Asymmetry Transducer MM 0036. Some definitions of these parameters are given below. The relationships between radiant temperature asymmetry resulting from heated ceilings and cold surfaces such as windows and the percentage of people expressing discomfort are also shown (Figs. 4.7 and 4.8).

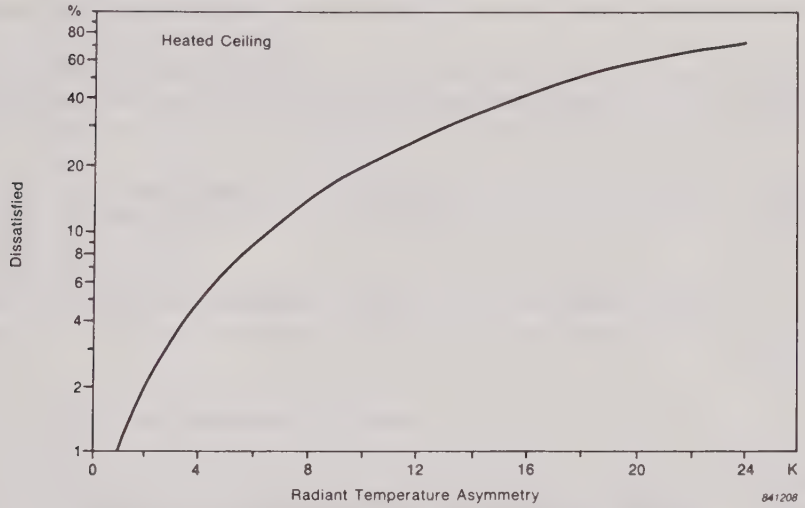


Fig. 4.7. Relationship between Radiant Temperature Asymmetry (from heated ceilings) and % dissatisfied

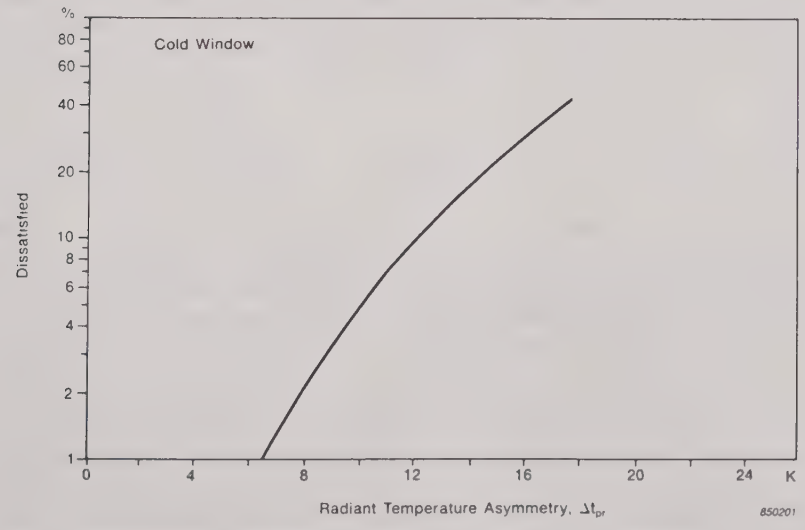


Fig. 4.8. Relationship between Radiant Temperature Asymmetry (from cold windows or walls) and % dissatisfied

ISO 7730 provides two recommendations concerning radiant temperature asymmetry. The first of these states that the radiant temperature asymmetry from windows or other cold surfaces should be less than 10°C (50°F) in relation to a small vertical plane 0,6 m above the floor. The second recommendation is that the radiant temperature asymmetry from a warm (heated) ceiling should not exceed 5°C (41°F) in relation to a small horizontal plane 0,6 m above the floor.

4.6.1. Definition of Radiant Temperature Terms

Mean Radiant Temperature ($\bar{t}_r$): is the uniform temperature of the surface of an imaginary enclosure where the radiant exchange of heat between this enclosure and a man would be equal to the radiant exchanges in the actual environment.

Plane Radiant Temperature (t_{pr}): is the uniform surface temperature of an enclosure in which the incident radiant flux on one side of a small plane element is the same as in the actual environment.

Radiant Temperature Asymmetry (Δt_{pr}): is the difference between the plane radiant temperature of the two opposite sides of a small plane element.

4.6.2. Use of the Radiant Temperature Asymmetry Transducer

The Radiant Temperature Asymmetry Transducer MM 0036 can simultaneously measure the plane radiant temperature in two opposite directions. Similarly, the incident power on the two sides of the Transducer can be measured and displayed.

By activating the "Asymmetry" pushkey, a difference measurement between the two measurement faces of the Transducer is obtained. Both the plane radiant temperature difference and the incident power difference are displayed simultaneously. If the "Asymmetry" pushkey is activated a second time a bar–graph Display such as that shown in Fig. 2.5 can be obtained. This type of Display is useful for determining the direction in which asymmetry is greatest.

Note: The bar–graph Display can only be obtained when metric measurement units are selected.

The sensitive elements of the Radiant Temperature Asymmetry Transducer are protected by Radiation Transparent Windshields. Under normal circumstances these Windshields will not reduce the transmission of radiant heat. However, the Windshields should be checked, before measurements are made, to ensure that they have not become scratched. Damaged Windshields should be replaced as follows:

1. Unscrew the retaining ring which holds the Windshield in position.
2. Remove the damaged Windshield and replace with a new Windshield.
3. Replace the retaining ring and screw tight.
4. Repeat for the Windshield on the other side of the Transducer if necessary.

A set of 16 Windshields is supplied with the Radiant Temperature Asymmetry Transducer. Additional sets can be ordered using B & K order number UA 0851.

4.6.3. Range of Radiant Temperature Measurements

The range over which plane radiant temperature measurements can be made using the Radiant Temperature Asymmetry Transducer is dependent upon the air temperature (t_a) and is given by the relationship:

$$t_a - 50°C < t_{pr} < t_a + 50°C$$

Some ranges for plane radiant temperature for various air temperatures are shown in Table 4.3.

The range for radiant temperature asymmetry measurements is – 100°C to + 100°C (– 148°F to + 212°F) and is independent of the air temperature.

Air Temperature t_a °C	Plane Radiant Temperature Range t_{pr} °C
–20	~ –70 to 30
20	–30 to 70
40	–10 to 90

T00686GB0

Table. 4.3. Measurement ranges for Plane Radiant Temperature for different Air Temperatures

4.6.4. Calculation of Mean Radiant Temperature

The Radiant Temperature Asymmetry Transducer can be used to obtain a very accurate mean radiant temperature value. The Transducer should be located as accurately as possible in a fixed position using, for example, a tripod (Fig. 4.9). Measurements of the plane radiant temperature in the two opposite directions should then be made and noted. The Transducer should then be rotated, about its long axis, through 90° and the measurements repeated (centre diagram). A third set of measurements, with the Transducer oriented to measure the vertical plane radiant temperatures should then be made.

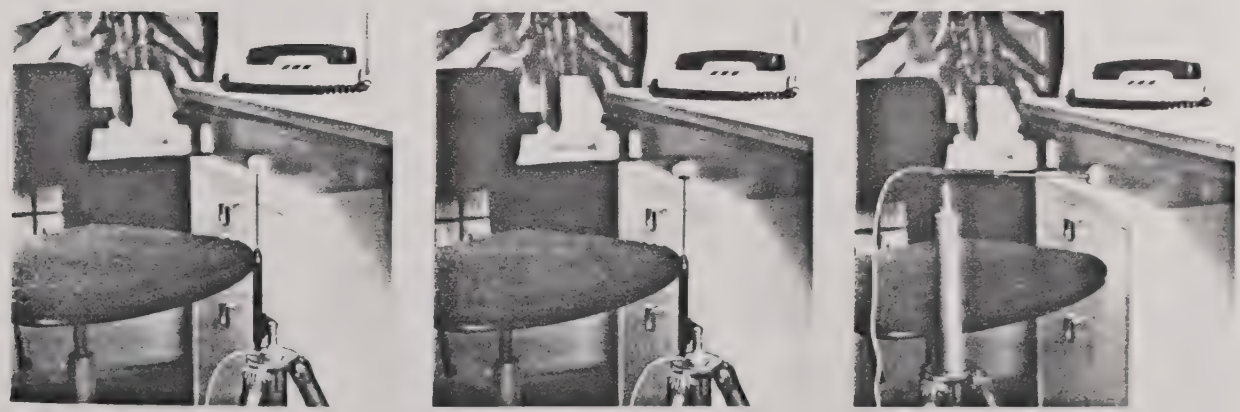


Fig. 4.9. Orientation of the Radiant Temperature Asymmetry Transducer for the calculation of Mean Radiant Temperature

Position of person	Projected area factors		
	Up/Down	Right/Left	Front/Back
Standing	0,08	0,23	0,35
Sitting	0,18	0,22	0,30

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Table. 4.4. Projected area factors for a person, standing and sitting

The mean radiant temperature can then be calculated by multiplying the six measured values by the relevant projection factors given in Table 4.4, adding the resultant data and dividing the result by the sum of the projected area factors. i.e. for a sitting person:

$$\bar{t}_r = \frac{0{,}18\,(t_{pr}[\text{up}] + t_{pr}[\text{down}]) + 0{,}22\,(t_{pr}[\text{right}] + t_{pr}[\text{left}]) + 0{,}30\,(t_{pr}[\text{front}] + t_{pr}[\text{back}])}{2\,(0{,}18 + 0{,}22 + 0{,}30)}$$

and for a standing person:

$$\bar{t}_r = \frac{0{,}08\,(t_{pr}[\text{up}] + t_{pr}[\text{down}]) + 0{,}23\,(t_{pr}[\text{right}] + t_{pr}[\text{left}]) + 0{,}35\,(t_{pr}[\text{front}] + t_{pr}[\text{back}])}{2\,(0{,}08 + 0{,}23 + 0{,}35)}$$

$\bar{t}_r$ = mean radiant temperature;

$\bar{t}_{pr}$ = plane radiant temperature.

Where the orientation of the person is not fixed, the average of the Right/Left and Front/Back projected area factors is used.

5. USE OF TYPE 1213 WITH OTHER B & K INSTRUMENTS

5.1. LEVEL RECORDER TYPE 2317

The B & K Level Recorder Type 2317 is a general purpose portable instrument which may be connected to the Indoor Climate Analyzer Type 1213. Recording Paper QP 0102 should be fitted in the Type 2317. For full operating details, the Instruction Manual of this instrument should be consulted.

5.1.1. Connection

In order to either record real-time measurements directly from the Indoor Climate Analyzer, or for replaying measured data stored in the Analyzer Memory, a Coaxial BNC Cable AO 0087 is required. For recordings when the Analyzer is in Display Mode, the Cable may be connected to either the "X–Out" or "Y–Out" output sockets. The socket selected will depend on the parameter to be output. See Table 2.1 for the outputs available from each socket and the output voltages. When replaying data stored in the Analyzer Memory, the Cable should always be connected to "Y–Out" of the Analyzer and to the SIGNAL INPUT socket of the Level Recorder and a Remote Control Cable AQ 0034 should be connected from the RECORDER socket of the Analyzer to the REMOTE CONTROL socket of the Level Recorder Type 2317.

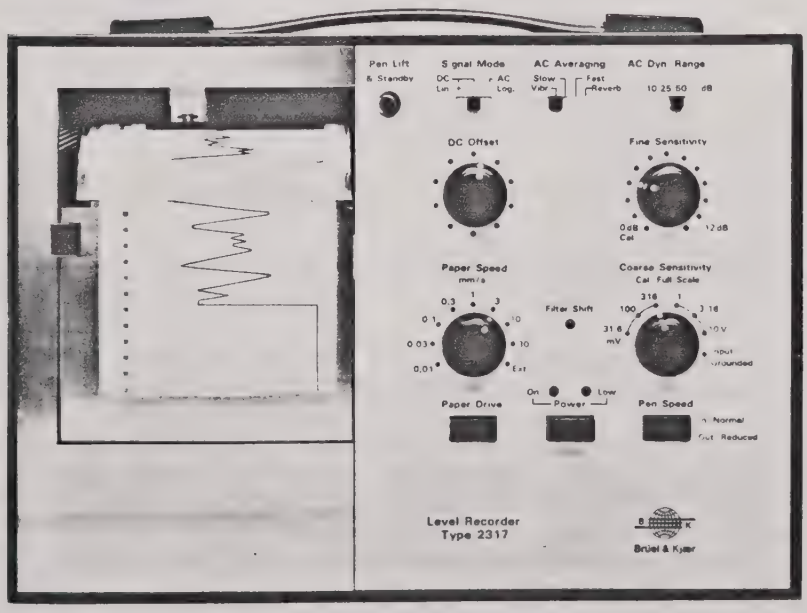

Fig. 5.1. Level Recorder Type 2317

The pin connections for the RECORDER socket via which control pulses are sent between the Analyzer and the Level Recorder are shown in Fig. 2.7.

5.1.2. Calibration

To calibrate the Level Recorder using the signals from the Analyzer proceed as follows:

1. Fit Recording Paper QP 0102 to the Level Recorder.

2. Set the following controls on the Level Recorder:

PEN LIFT & STANDBY:	"Out"
SIGNAL MODE:	"DC Lin +"
AC AVERAGING:	"Fast"
AC DYN. RANGE:	"50 dB"
DC OFFSET:	To be adjusted
FINE SENSITIVITY:	"– 12 dB"
PAPER SPEED:	"Ext."
COARSE SENSITIVITY:	"3,16 V"
PAPER DRIVE:	"In"
POWER:	"On"
PEN SPEED:	"Out"

3. Switch on the Analyzer and allow the self-test routine to run (see Chapter 3 for power supply details, etc.).

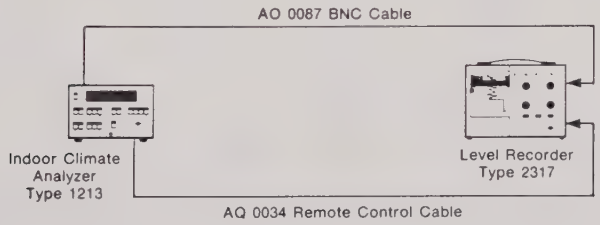

Fig. 5.2. Connection of Level Recorder Type 2317 to Indoor Climate Analyzer

4. Select the desired units of measurements using the "120/Units" pushkey on the Analyzer (i.e. Metric or Imperial).

   Important Note: The full scale readings for Metric and Imperial units are different. Care should be taken to both calibrate and plot in the same units.

5. Press the "Replay/Plot" pushkey on the Analyzer. The Display will indicate DISPLAY OR PLOT ?. Press the "Replay/Plot" pushkey again and the Display will indicate ZERO CALIBRATION. Adjust the "DC OFFSET" on the Level Recorder until the pen lines up with the centre of the Recorder Paper (see Fig. 5.3). The ZERO CALIBRATION output from the Analyzer corresponds to a zero voltage output.

6. Press the "Replay/Plot" pushkey on the Analyzer. The Display will indicate GAIN CALIBRATION. Adjust the "FINE SENSITIVITY" on the Level Recorder until the pen lines up with the left-hand line on the Recorder Paper. The GAIN CALIBRATION output from the Analyzer corresponds to an output voltage of + 5 V.

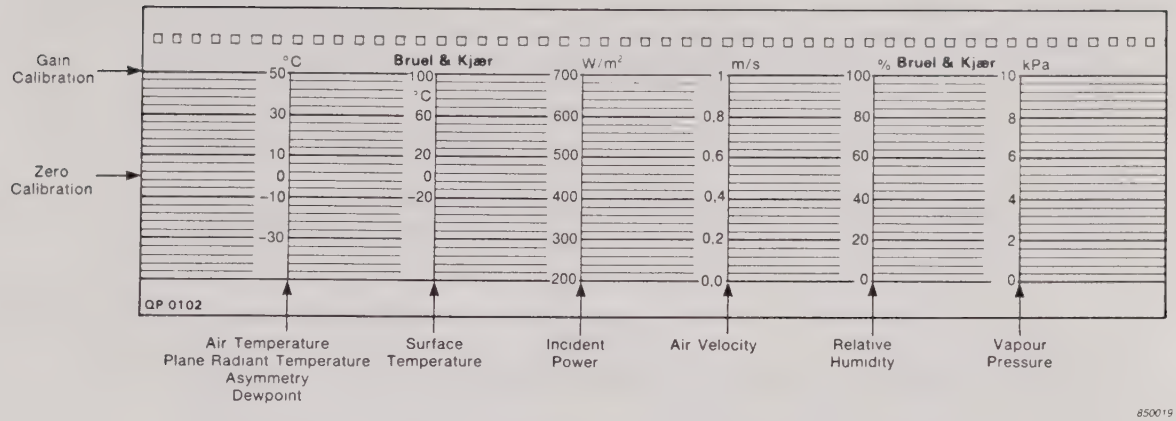

Fig. 5.3.a. Scaling of Recorder Paper (S.I. Units)

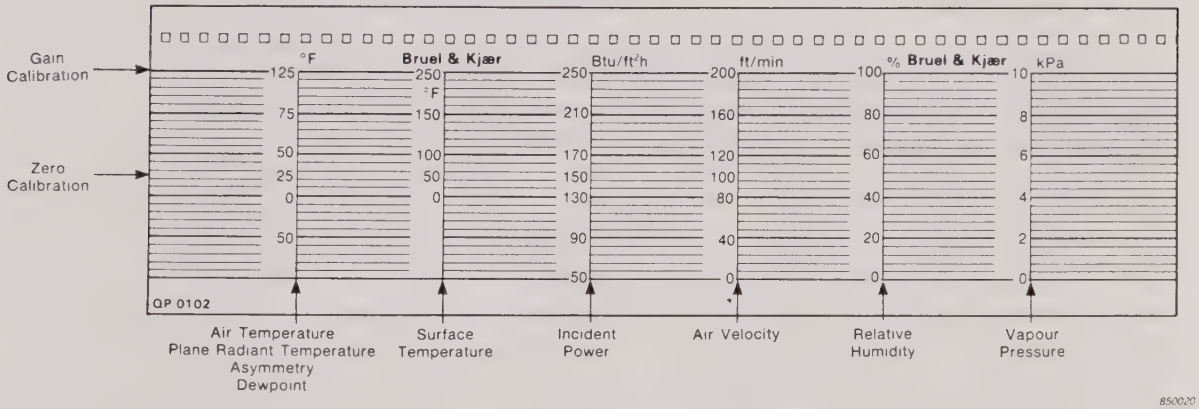

Fig. 5.3.b. Scaling of Recorder Paper (Imperial Units)

A higher resolution can be obtained by lining the zero volt signal up with the right-hand side of the Recorder Paper or by changing the SENSITIVITY settings on the 2317.

Note: For the GAIN calibration the Level Recorder should always be connected to the "Y–Out" socket of the Analyzer. Therefore, if real–time measurements of either instantaneous air velocity, or incident radiation on the B face of the Radiant Temperature Transducer are required, calibration should be performed using the "Y–Out" socket of the Analyzer.

Once calibration of the gain has been accomplished, the Cable should be disconnected from the "Y–Out" socket and reconnected to the "X–Out" socket of the Analyzer. The 2317 is now calibrated and ready for use in the recording of measurements.

5.1.3. Real-Time Recordings Using Level Recorder Type 2317

1. Connect and calibrate the Level Recorder as described in Sections 5.1.1 and 5.1.2.

2. Connect the Transducers to the Analyzer as described in Section 3.4.1.

3. Set the PAPER SPEED switch on the Level Recorder to a suitable paper speed. This will to some extent depend on the parameter and the duration for which recordings are to be made.

4. Press the "Display" pushkey.

5. Select the Transducer to be plotted on the Level Recorder, by pressing the appropriate TRANSDUCER pushkey.

5.1.4. Replaying of Stored Data Using Level Recorder Type 2317

1. Connect and calibrate the Level Recorder as described in Sections 5.1.1 and 5.1.2.

2. Press the "Replay/Plot" pushkey. The Display will indicate SELECT REPLAY DATA. Select the desired parameter to be replayed by pressing the appropriate TRANSDUCER pushkey on the Analyzer.

3. Press the "Replay/Plot" pushkey on the Analyzer and allow a set of data to be replayed from the Analyzer Memory. While data is being replayed the Display will indicate REPLAYING. The replaying of memory data is completed when the Display indicates SELECT TRANSDUCER and the Analyzer returns to the "Display" mode.

4. Repeat items 2 to 3 for other parameters.

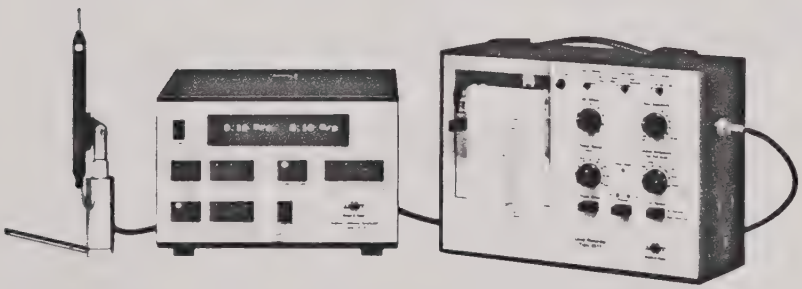

Fig. 5.4. Recording of instantaneous air velocity using Level Recorder Type 2317

5.2. X–Y RECORDER TYPE 2308

The X–Y Recorder Type 2308 may be connected to the Indoor Climate Analyzer Type 1213 in order to obtain permanent graphical records of measurements stored in the Analyzer Memory. Two types of Recording Paper are available; QP 3571 for measurements in metric units and QP 3572 for measurements in imperial units. For full operating instructions the Instruction Manual for the X–Y Recorder should be consulted.

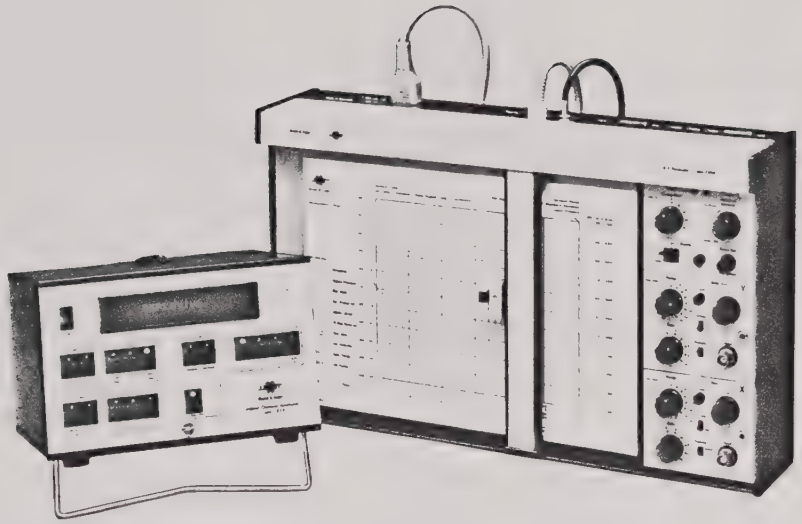

Fig. 5.5. Recording stored measurement data using the X–Y Recorder Type 2308

5.2.1. Connection

In order to replay data stored in the Analyzer Memory a BNC Coaxial Cable AO 0087 and a Remote Control Cable AQ 0034 are required. The Coaxial Cable should be connected to the Y–OUTPUT of the Analyzer to enable output of all recorded parameters. The other end of the cable should be connected to the Y–INPUT socket of the X–Y Recorder. **Note:** There are two Y–INPUT sockets on the X–Y Recorder, either of which may be used.

The Remote Control Cable should be connected from the RECORDER socket of the Analyzer to the REMOTE 1 socket of the X–Y Recorder.

The pin connections for the RECORDER socket, via which control pulses are sent between the Analyzer and the X–Y Recorder, are shown in Fig. 2.7.

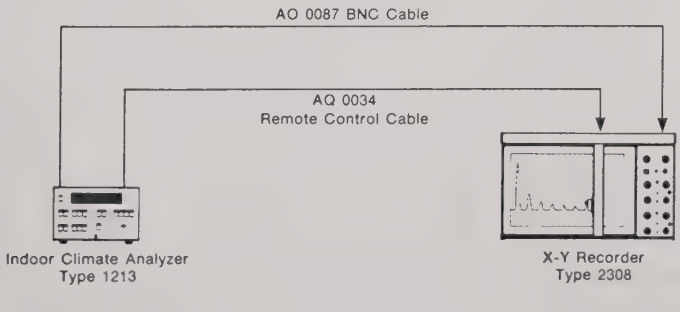

Fig. 5.6. Connection of X–Y Recorder Type 2308 to Indoor Climate Analyzer

5.2.2. Calibration

To calibrate the X–Y Recorder using the signals from the Analyzer, proceed as follows:

1. Connect a mains supply to the X–Y Recorder and mount a pen on the pen holder as described in the Instruction Manual for the instrument.

2. Switch on the Analyzer and allow the self-test routine to run (See Chapter 3 for details of powering, etc.).

3. Place a sheet of preprinted Recording Paper (either QP 3571 or QP 3572) on the platen of Recorder and align the paper with the left and bottom edges of the platen.

4. Set the FUNCTION SELECTOR switch on the X–Y Recorder to "Paper Hold" and smooth the paper down.

5. Set the other controls on the X–Y Recorder as follows:

SWEEP RATE:	"20 mm/s"
SWEEP:	"Hold"
Y–RANGE:	"50 mV/mm"
Y–SWEEP:	"Ext."
Y–POLARITY:	"Norm."
Y–GAIN:	"Cal." click-stop position
X–RANGE:	"20 mV/mm"
X–SWEEP:	"Ext."
X–POLARITY:	"Norm."
X–GAIN:	"Cal." click-stop position

6. If necessary, select the desired measurement units by activating the "120 h/Units" pushkey on the Analyzer.

   Note: The full-scale signals are different for the different unit systems (i.e. Metric or Imperial).

7. Change the FUNCTION SELECTOR switch to "Servo On" and press the "Replay-/Plot" pushkey on the Analyzer twice. The pen carriage of the X–Y Recorder will move. The position of the carriage and pen should then be adjusted using the Y–ZERO SET and X–ZERO SET knobs on the X–Y Recorder, until the pen is positioned above the zero circle on the Recorder Paper. To ensure that the pen is in the correct position it can be lightly pushed down to make a mark on the paper. Continue adjustment until this mark coincides with the dot at the centre of the "Zero" circle.

8. Press the "Replay/Plot" pushkey on the Analyzer. The pen carriage of the X–Y Recorder will move. The position of the carriage and pen should then be adjusted by reducing the gain, using the Y–GAIN and X–GAIN knobs on the X–Y Recorder, until the pen is positioned over the "Gain Cal." circle on the Recorder Paper. To ensure that the pen is in the correct position it can be lightly pushed down to make a mark on the paper. Continue adjustment until this mark coincides with the dot at the centre of the "Gain Cal." circle.

The 2308 is now calibrated and ready for the replaying of data stored in the memory of the Analyzer.

5.2.3. Replaying of Stored Data Using X–Y Recorder Type 2308

1. Connect and calibrate the X–Y Recorder as described in sections 5.2.1 and 5.2.2.

2. Press the "Replay/Plot" pushkey on the Analyzer. SELECT REPLAY DATA will appear on the Display of the Analyzer. Select the data to be recorded by pressing one or more TRANSDUCER pushkeys on the Analyzer.

   Note: If the different parameters are to be plotted using different colour pens, only one TRANSDUCER pushkey should be selected at a time.

3. Press the "Replay/Plot" pushkey to activate the replaying of data from the Memory.

Control pulses from the Analyzer result in different types of dotted line being used for the different parameters. This together with the use of different colour pens enables all measurement data to be clearly reproduced on a single graph.

Note: If solid line plots are preferred, the FUNCTION SELECTOR switch on the X–Y Recorder can be set to "Pen Down".

The Analyzer provides a pulse signal which marks both the Recording Time that was used for the recording and the parameter being replayed. The position of the Recording Time mark depends on the units of measurement selected and so provides a useful check that the measurement units selected for output are compatible with the Recording Paper used (see Fig. 5.7).

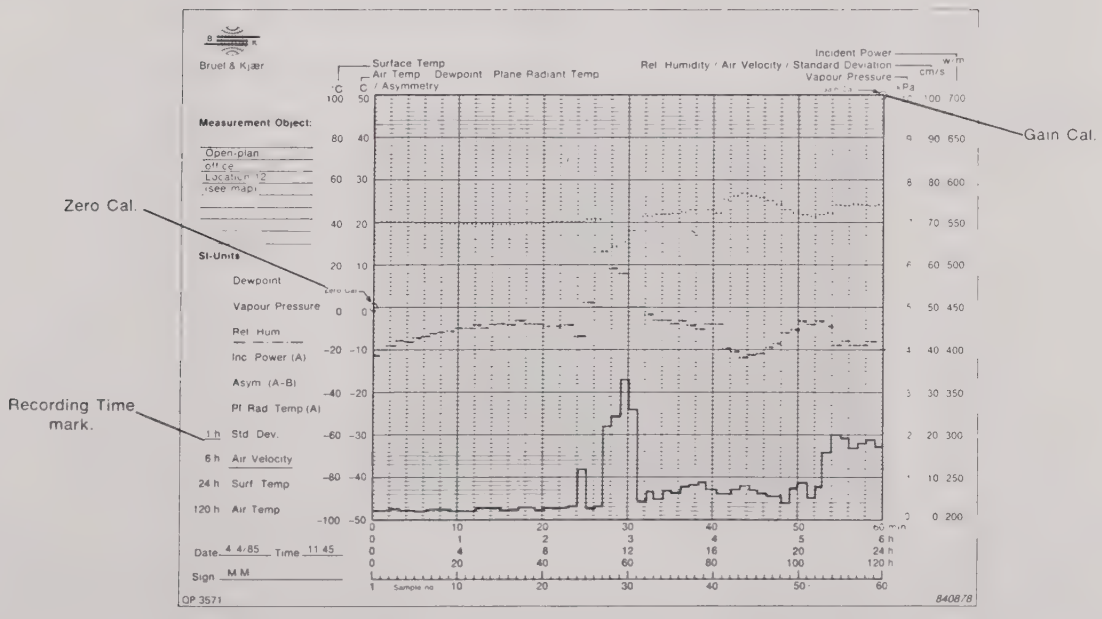

Fig. 5.7.a. Metric Recording Paper QP 3571 for X–Y Recorder Type 2308 with typical curve

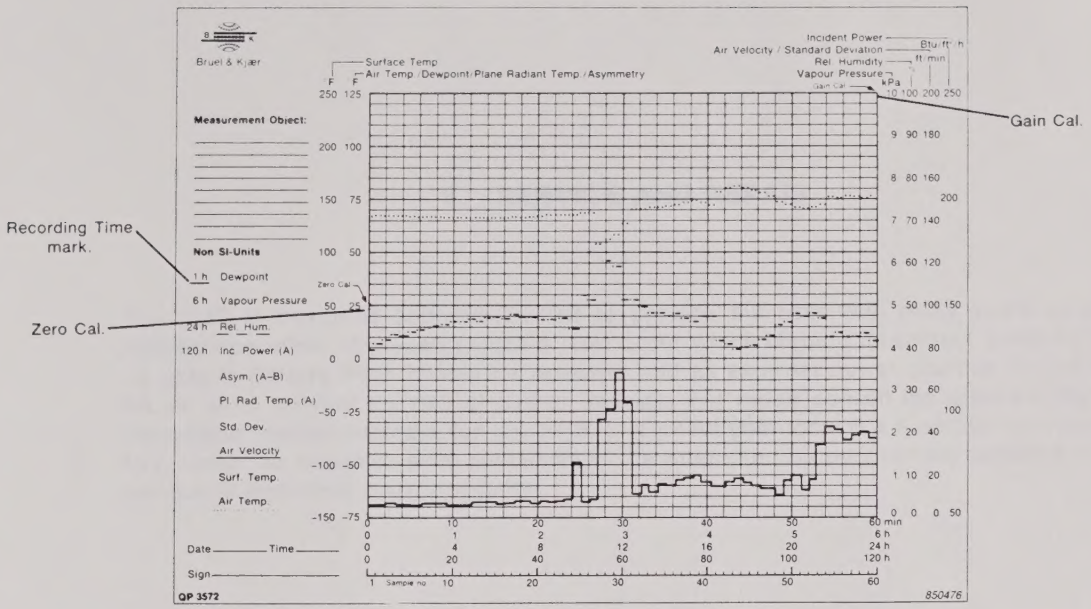

Fig. 5.7.b. Imperial Recording Paper QP 3572 for X–Y Recorder Type 2308 with typical curve

5.2.4. Instantaneous Air Velocity Recordings

1. Connect and calibrate the X–Y Recorder as described in sections 5.2.1 and 5.2.2.

2. Change the Coaxial Cable connection to the X–OUTPUT of the Analyzer.

3. Press the "Replay/Plot" pushkey on the Analyzer. SELECT REPLAY DATA will appear on the Display of the Analyzer. Select the AIR VELOCITY "Mean Value" pushkey.

4. Press the "Replay/Plot" pushkey to commence recording.

6. SERVICE AND REPAIR

The 1213 is designed and constructed to provide the user with many years of safe, reliable operation. However, should a fault occur which impairs its correct function, then its plug-in Battery Pack should be removed and all external power sources disconnected, so as to prevent the risk of further damage. For repair consult the separate Service Instruction Manual available for the 1213, or contact your local B & K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.

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